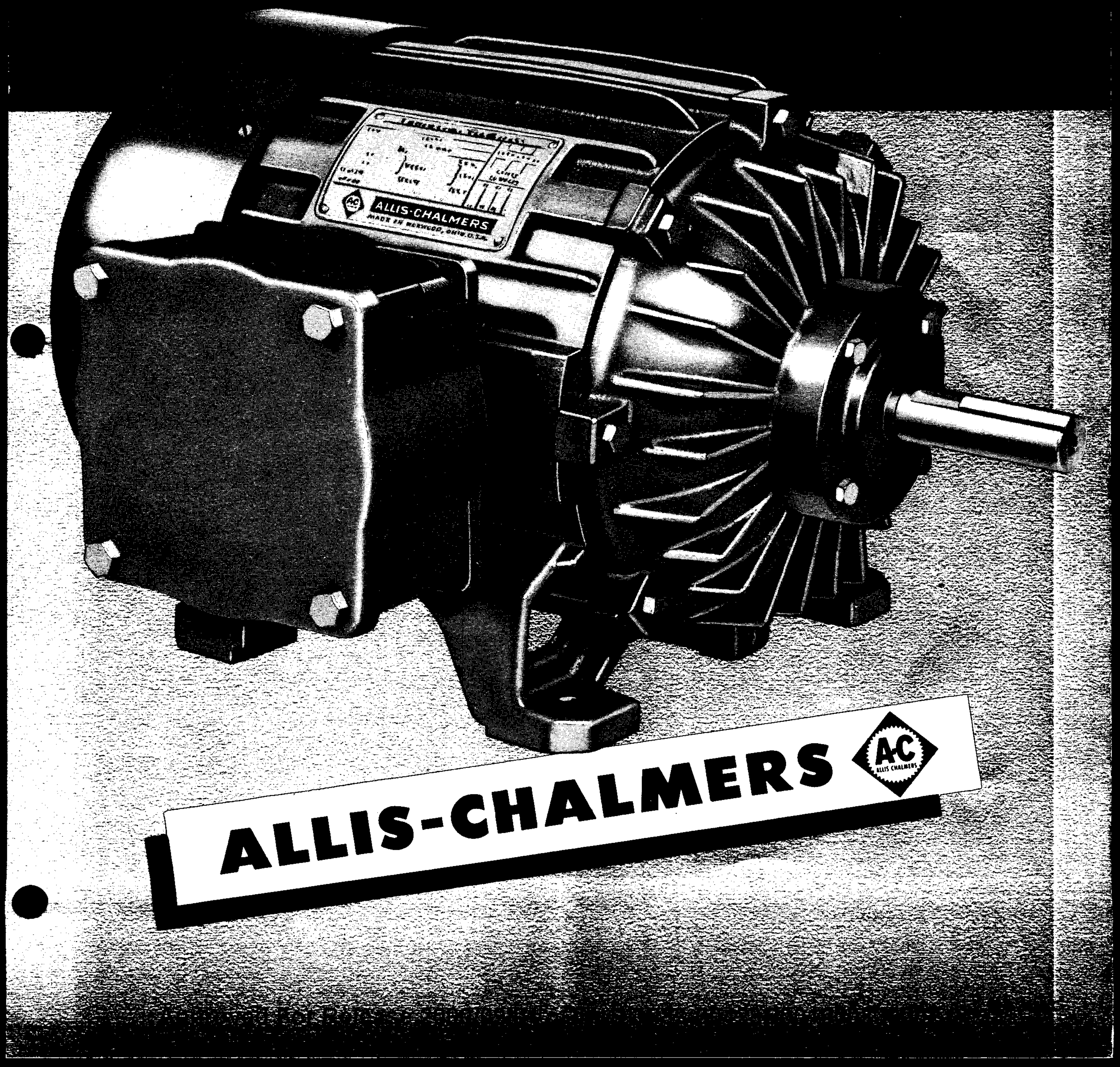
Explosion-Proof

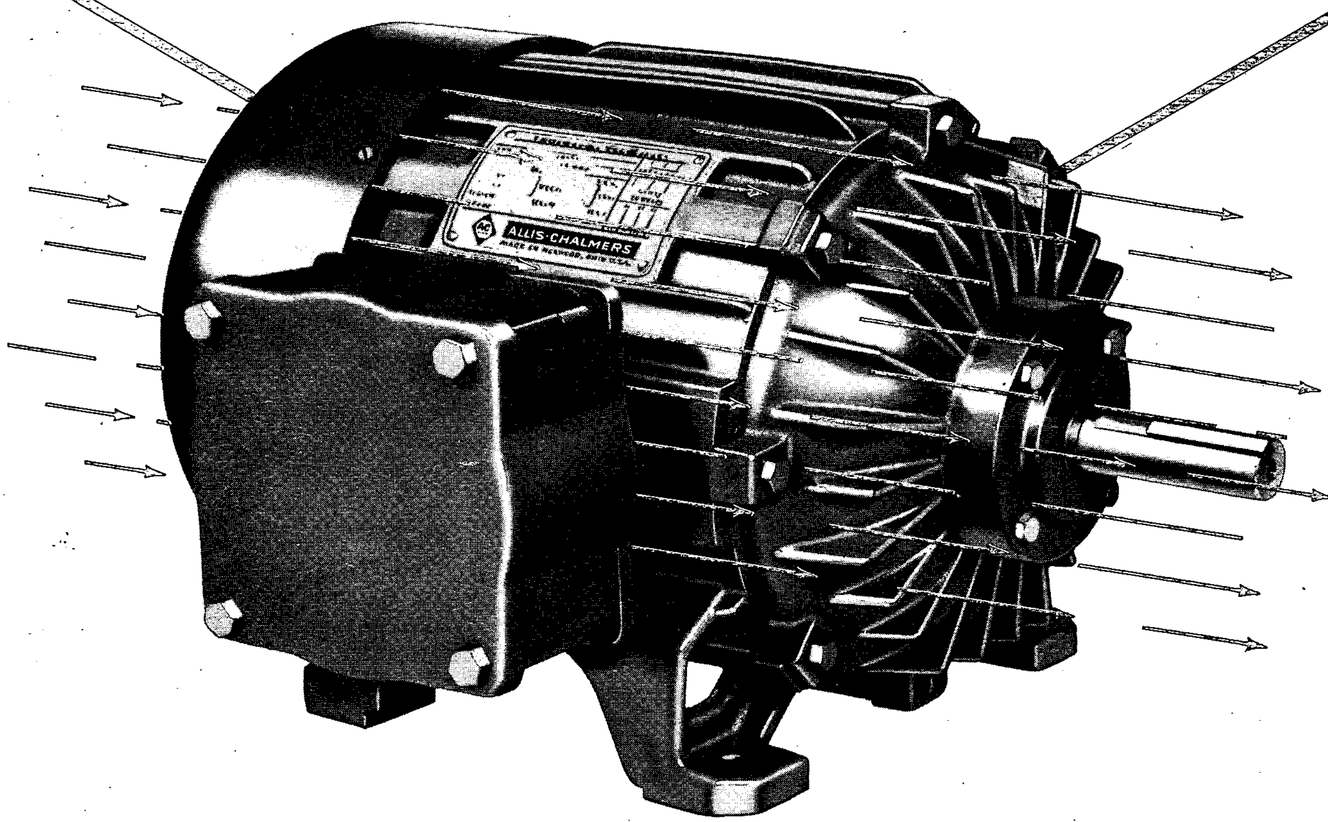
FAN-COOLED & NON-VENTILATED MOTORS

Types APZZ and APKK



LESS MAINTENANCE - EASIER MAINTENANCE

...with NEW Cooling System



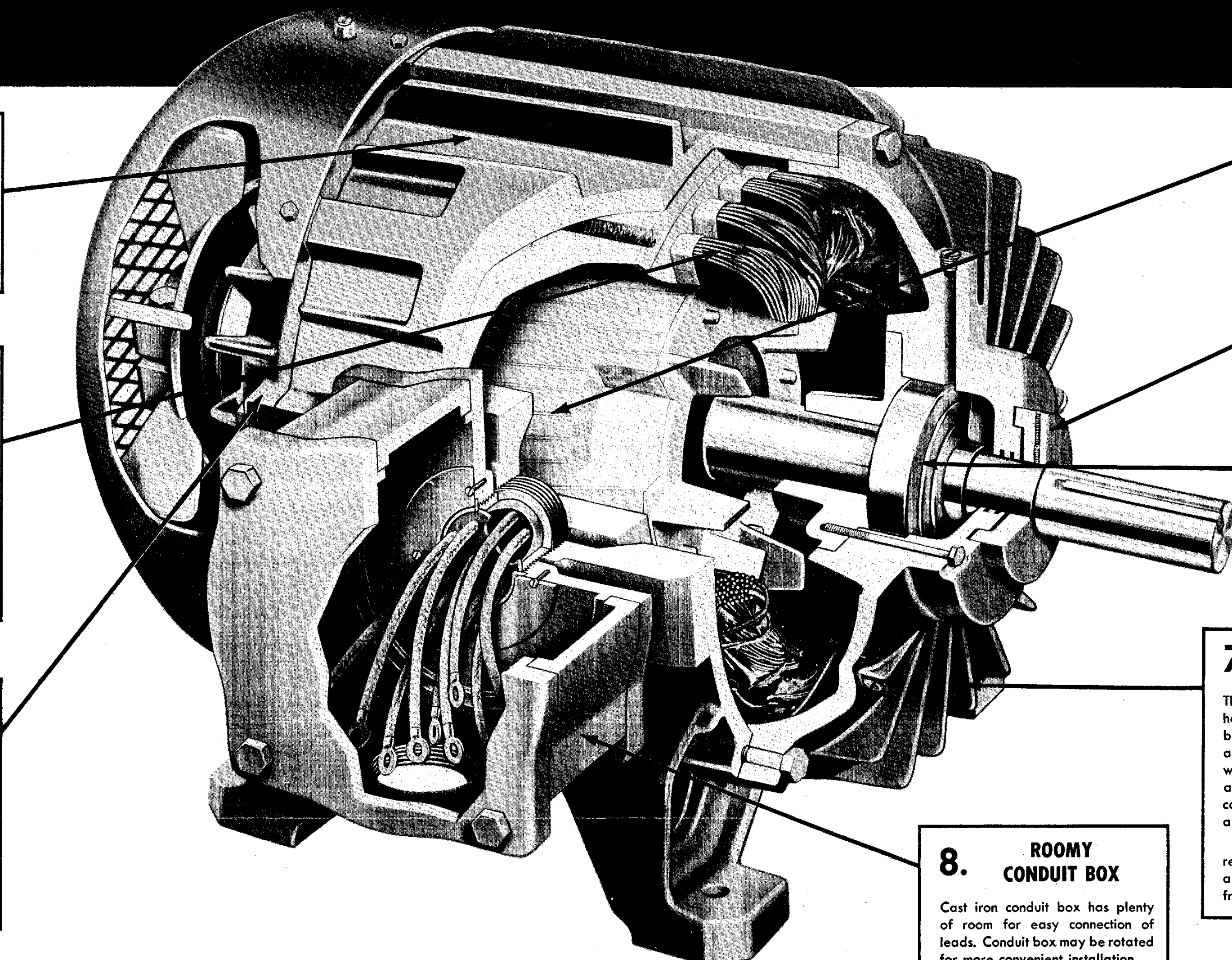
Your maintenance costs will be cut to a new low when you use this new Allis-Chalmers Type APZZ explosion-proof motor. It cleans itself. When the fan blows cooling air over the exposed ribs, it also blows dust and dirt away. You can mount it anywhere—even in hard-to-get-at locations with no worry about clogged-up air passages.

The efficiency of the cooling system is not impaired by long periods of operation. Since enclosed external air passages have been eliminated, no insulating wall of dirt and dust can build up inside the frame to hold in heat.

If dirt and dust stick to the cooling ribs in oily or humid locations, you can clean them in a few minutes with an air hose, vacuum cleaner or brush. If necessary, the fan housing can be removed to expose the entire cooling area. This combination of easy maintenance and cooling system efficiency makes the Allis-Chalmers explosion-proof motor ideal for use where there is dust, dirt, fly ash, rain, snow, or corrosive gases.

If service is needed, call one of the 95 Allis-Chalmers Certified Service Shops—located in every major industrial area of the United States. They give you complete facilities, highly skilled workmen, modern equipment, and assured integrity. Your nearest Allis-Chalmers Certified Service Shop guarantees you prompt service and fine workmanship, plus factory-approved procedures and parts.

ALLIS-CHALMERS



1. NEW RIBBED FRAME

Stiff cast iron frame resists corrosion. Bearings last longer because alignment is rigidly held. Working parts are protected against distortion, blows and other physical damage.

2. STATOR DOUBLE INSULATED

Great care is taken to protect the stator from electrical damage as well as the cast iron frame protects it from physical damage. It is dipped several times in a special insulating varnish and baked in an automatic continuous oven after each dipping. Result is a stator both physically and electrically strong . . . thoroughly protected against moisture and corrosion.

3. IMPROVED HEAT DISPERSAL

Cooling ribs are cast integrally with the yoke; air is blown over them without restriction. There are no enclosed external air passages to clog up with dirt and thereby ruin cooling efficiency. Cleaning, when required, is a few moments work with an air hose, brush or vacuum cleaner.

4. DIE CAST ROTOR

The rotor cage is pressure cast of aluminum with integrally cast fans in the smaller sizes. In the larger sizes copper bars are brazed to copper end rings. This construction is practically indestructible since there are no rivets or bolts to loosen.

5. ROTATING SEALS

Supplied on both ends of motor. Setscrewed to shaft. Close running clearance. Keep dirt and moisture out of bearing chambers.

6. DOUBLE-SHIELDED BEARINGS

Ball bearings are double-shielded with provision for in-service lubrication for long, trouble-free bearing life. Shielded construction prevents over-greasing, which is the most common cause of bearing failure.

7. RIBBED END SHIELDS

The wall of each end shield casting is thick and heavily ribbed. This provides rigid support for the bearing, additional surface area for heat dissipation and plenty of strength to resist internal explosion without distortion. A cast bearing cap and flame arrester prevents flame from entering the bearing cavity or reaching the atmosphere. Underwriters approved.

Grease chambers are large to make frequent replenishment unnecessary. Also, the grease provides additional sealing against bearing contamination from extremely adverse dirt conditions.

8. ROOMY CONDUIT BOX

Cast iron conduit box has plenty of room for easy connection of leads. Conduit box may be rotated for more convenient installation.

...Laboratories Inc.

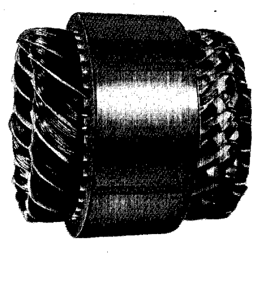
Approved For Release 2000/09/01 : CIA-RDP83-00423R001000330002-2

STATOR PROTECTED MECHANICALLY AND ELECTRICALLY

The silicon steel laminations of the stator core are welded together in a rigid unit to serve as a base for windings. Windings are assembled into the core, using a specially developed flexible tear resistant slot cell paper. The flexible plastic insulation on the coil wire gives high dielectric and mechanical strength.

On all stators except open slot designs, stator coils are joined by compression type connectors, a great improvement over soldered connections because they use no heat, are stronger than the wires themselves, and assure uniform conductivity.

After assembly, the stator is dipped several times in a special insulating varnish and baked in a continuous

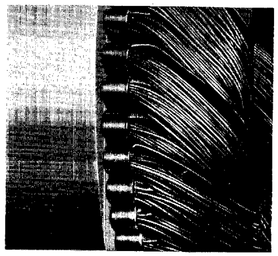


automatic oven after each dip, increasing dielectric strength and protecting coils and laminations against moisture and corrosion.

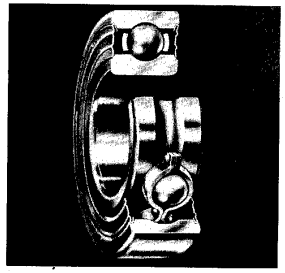
The finished core is pressed into the yoke and held in place by spot welding through holes in the yoke under the nameplate.

Frames 364 and larger have cores stacked in the yoke and held in position by a key and retaining ring. The stacked stator is wound and treated as above.

INTERPHASE INSULATION GIVES EXTRA PROTECTION



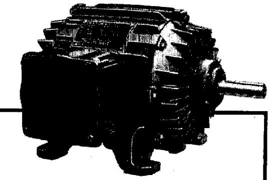
Heavy varnished cambric insulation is inserted between the phase windings to give extra protection against electrical breakdown. This is one more Allis-Chalmers detail that adds protection from every possible source of motor trouble.



DOUBLE SHIELDED BEARINGS

Ball bearings and bearing closures are filled with the right amount of the right grease at the factory and are delivered ready for operation. They are double-shielded, with provision for in-service lubrication.

The bearing receives full support of the end shield and is close to the load. The end shield may be removed easily.



SIMILAR DESIGN IN NON-VENTILATED TYPE

Motors of this same basic design also may be furnished without fan or fan housing, as explosion-proof, non-ventilated, Type APKK. The additional cooling area provided by the cooling fins, as compared with conventional design, gives the APKK motor an extra reserve of cooling capacity when used in unusually dirty locations or where high ambient temperatures are encountered. Ratings, sizes and dimensions for APKK motors are included on the last page of this bulletin.

HORSEPOWER - FRAME CHART

Hp	Rpm - 60 Cycles 3600	1800	1200	900	720	600
½	......	......	......	204	224	225
¾	......	......	203	224	254	254
1	......	203	204	225	254	254
1½	204	204	224	254	254	284
2	204	224	225	254	284	324
3	224	225	**254**	**284**	324	326
5	225	**254**	**284**	**324**	326	365
7½	254	**284**	**324**	**326**	365	404
10	284	**324**	**326**	**364**	404	405
15	324	**326**	**364**	**365**	405	444
20	326	**364**	**365**	**404**	444	445
25	365S	**365**	**404**	**405**	445	504U
30	404S	**404**	**405**	**444**	504U	505
40	405S*	**405**	**444**	**445**	505	.....
50	444S*	**444S***	**445**	504U	.....	.....
60	445S*	**445S***	504U*	505*	.....	.....
75	504S*	504S*	505*	.....	.....	.....
100	505S*	505S*	......	.....	.....	.....

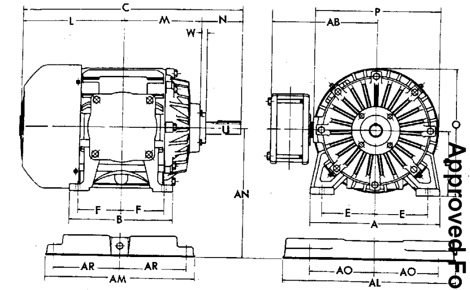
Motors above line are non-ventilated, NEMA Design B (APKK) only. For Design C and D consult your dealer or sales office.

Motors below line are fan-cooled type (APZZ). Frame numbers not otherwise marked apply to Design B, or in some cases to Design A. Bold-face numbers apply to Design C also; for other Design C ratings consult your dealer or sales office. Asterisked (*) frames available only in Design A, or in Design A and C if bold-faced.

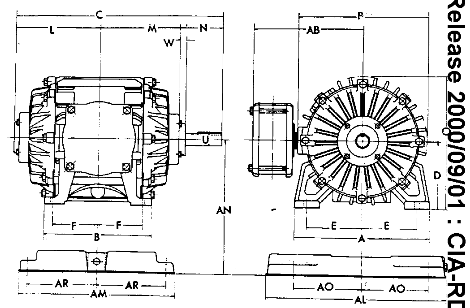
Explosion-proof motors larger than those listed above are built in AZZ and ANZZ types, with tube-type air-to-air heat exchangers. See bulletins 51B7149 and 05B7150.

FAN-COOLED

Frames 404 and larger have slide rails instead of bases shown for smaller frames.



NON-VENTILATED



DIMENSIONS IN INCHES

Frame	Weight* (1)	Weight* (2)	Key	A	B	C (1)	C (2)	D	E	F	L (1)	L (2)	M	N	O	P	U	W	AB	AL	AM	AN	AO	AR
203	110	....	3/16 3/16 1⅜	9¾	6¾	13⅞	...	5	4	2¾	5¾	...	5⅝	2½	9¾	9½	.750	¼	8⅞	14	11	6¾	5	4¾
204	120	....	3/16 3/16 1⅜	9¾	7¾	14⅞	...	5	4	3¼	6¼	...	6⅛	2½	9¾	9½	.750	¼	8⅞	14	12	6¾	5	5¼
224	160	170	¼ ¼ 2	10¾	8¼	16⅝	18½	5½	4½	3⅜	6¾	8⅝	6⅝	3¼	10 13/16	10⅝	1.000	¼	9⅛	15½	12¼	7¼	5½	5⅜
225	170	180	¼ ¼ 2	10¾	9	17⅜	19¼	5½	4½	3¾	7⅛	9	7	3¼	10 13/16	10⅝	1.000	¼	9⅛	15½	13	7¼	5½	5¾
254	220	250	¼ ¼ 2⅜	11¾	10	20	22 1/16	6¼	5	4⅛	8¼	10 5/16	8⅛	3⅝	12	11½	1.125	¼	9½	17¾	15⅛	8¼	6¼	6⅝
284	....	320	¼ ¼ 2¾	12¾	11¾	..	24¾	7	5½	4¾	..	11½	9¼	4	13¼	12½	1.250	¼	10⅛	19¾	16⅞	9	7	7½
324	....	430	⅜ ⅜ 3¾	14¾	12¾	..	28¼	8	6¼	5¼	..	12⅞	10¼	5⅛	15⅝	15¼	1.625	¼	12½	22¾	19¼	10½	8	8½
326	....	470	⅜ ⅜ 3¾	14¾	14¼	..	29¾	8	6¼	6	..	13⅝	11	5⅛	15⅝	15¼	1.625	¼	12½	22¾	20¾	10½	8	9¼
364	....	800	½ ½ 4¼	17½	14	..	31⅛	9	7	5⅝	..	14	11¼	5⅞	18½	19	1.875	¼	14 1/16	25½	20½	11½	9	9⅛
364-S	....	800	⅜ ⅜ 1⅞	17½	14	..	28¾	9	7	5⅝	..	14	11¼	3½	18½	19	1.625	¼	14 1/16	..	..	..	..	..
365	....	875	½ ½ 4¼	17½	15	..	32⅛	9	7	6⅛	..	14½	11¾	5⅞	18½	19	1.875	¼	14 1/16	25½	21½	11½	9	9⅝
365-S	....	875	⅜ ⅜ 1⅞	17½	15	..	29¾	9	7	6⅛	..	14½	11¾	3½	18½	19	1.625	¼	14 1/16	..	..	..	..	..
404	....	1050	½ ½ 5	19½	15¼	..	34⅜	10	8	6⅛	..	15¼	12½	6⅝	20⅜	20⅝	2.125	¼	15 1/16	28½	22	13	10	9⅞
404-S	....	1050	½ ½ 2	19½	15¼	..	31¾	10	8	6⅛	..	15¼	12½	4	20⅜	20⅝	1.875	¼	15 1/16	..	..	..	..	..
405	....	1125	½ ½ 5	19½	16¾	..	35⅞	10	8	6⅞	..	16	13¼	6⅝	20⅜	20⅝	2.125	¼	15 1/16	28½	23½	13	10	10⅝
405-S	....	1125	½ ½ 2	19½	16¾	..	33¼	10	8	6⅞	..	16	13¼	4	20⅜	20⅝	1.875	¼	15 1/16	..	..	..	..	..
444	....	1400	⅝ ⅝ 5½	21½	17½	..	39⅝	11	9	7¼	..	17¾	14¼	7⅝	22⅝	23¼	2.375	½	16 5/16	31	24¼	14	11	11
444-S	....	1400	½ ½ 2¾	21½	17½	..	36¾	11	9	7¼	..	17¾	14¼	4¾	22⅝	23¼	2.125	½	16 5/16	..	..	..	..	..
445	....	1600	⅝ ⅝ 5½	21½	19½	..	41⅝	11	9	8¼	..	18¾	15¼	7⅝	22⅝	23¼	2.375	½	16 5/16	31	26¼	14	11	12
445-S	....	1600	½ ½ 2¾	21½	19½	..	38¾	11	9	8¼	..	18¾	15¼	4¾	22⅝	23¼	2.125	½	16 5/16	..	..	..	..	..
504-U	....	1900	¾ ¾ 7¼	24½	21	..	44⅛	12½	10	8	..	19	16¼	8⅞	24½	24½	2.875	¼	19½	34½	27¼	16	12½	12½
504-S	....	1900	½ ½ 2¾	24½	21	..	39¾	12½	10	8	..	19	16¼	4½	24½	24½	2.125	¼	19½	..	..	..	..	..
⌀504-S	....	1900	½ ½ 2¾	24½	21	..	39¾	12½	10	8	..	19	15 9/16	5 3/16	24½	24½	2.125	15/16	19½	..	..	..	..	..
505	....	2100	¾ ¾ 7¼	24½	23	..	46⅛	12½	10	9	..	20	17¼	8⅞	24½	24½	2.875	¼	19½	34½	29¼	16	12½	13½
505-S	....	2100	½ ½ 2¾	24½	23	..	41¾	12½	10	9	..	20	17¼	4½	24½	24½	2.125	¼	19½	..	..	..	..	..
⌀505-S	....	2100	½ ½ 2¾	24½	23	..	41¾	12½	10	9	..	20	16 9/16	5 3/16	24½	24½	2.125	15/16	19½	..	..	..	..	..

EVERY DETAIL DESIGNED FOR Low Maintenance Dependability Extra Protection

STATOR PROTECTED MECHANICALLY AND ELECTRICALLY

The silicon steel laminations of the stator core are welded together in a rigid unit to serve as a base for windings. Windings are assembled into the core, using a specially developed flexible tear resistant slot cell paper. The flexible plastic insulation on the coil wire gives high dielectric and mechanical strength.

On all stators except open slot designs, stator coils are joined by compression type connectors, a great improvement over soldered connections because they use no heat, are stronger than the wires themselves, and assure uniform conductivity.

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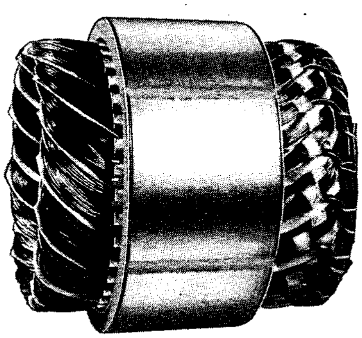

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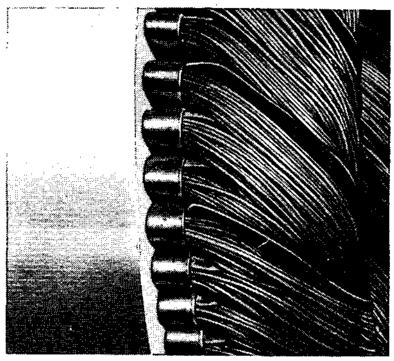

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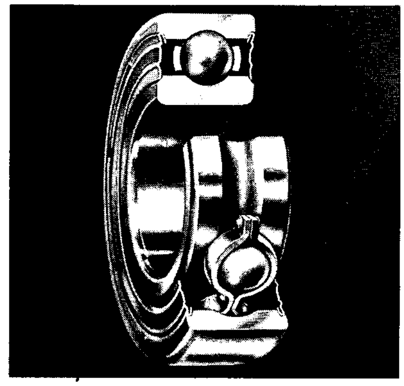

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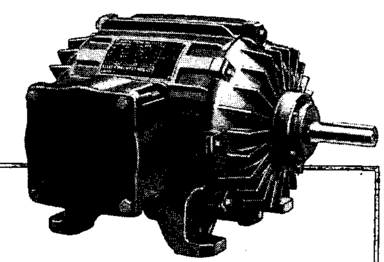
The bearing receives full support of the end shield and is close to the load. The end shield may be removed easily.



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MOTORS

ALLIS-CHALMERS

Ratings and Dimensions

HORSEPOWER - FRAME CHART

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½	......	......	......	204	224	225
¾	......	......	203	224	254	254
1	......	203	204	225	254	254
1½	204	204	224	254	254	284
2	204	224	225	254	284	324
3	224	225	**254**	**284**	324	326
5	225	**254**	**284**	**324**	326	365
7½	254	**284**	**324**	**326**	365	404
10	284	**324**	**326**	**364**	404	405
15	324	**326**	**364**	**365**	405	444
20	326	**364**	**365**	**404**	444	445
25	365S	**365**	**404**	**405**	445	504U
30	404S	**404**	**405**	**444**	504U	505
40	405S*	**405**	**444**	**445**	505	.....
50	444S*	**444S***	**445**	504U	.....	.....
60	445S*	**445S***	504U*	505*	.....	.....
75	504S*	504S*	505*	.....	.....	.....
100	505S*	505S*	......	.....	.....	.....

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FAN-COOLED

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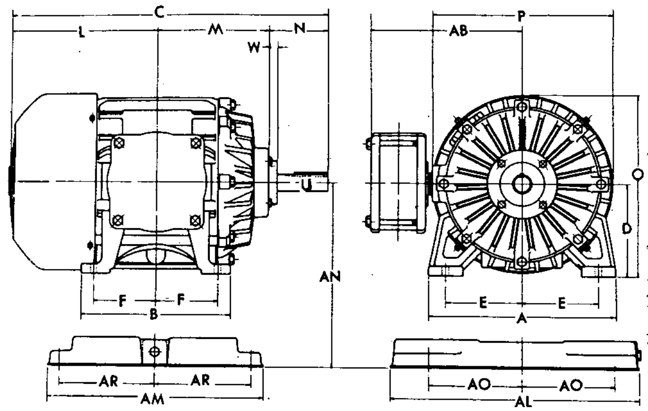
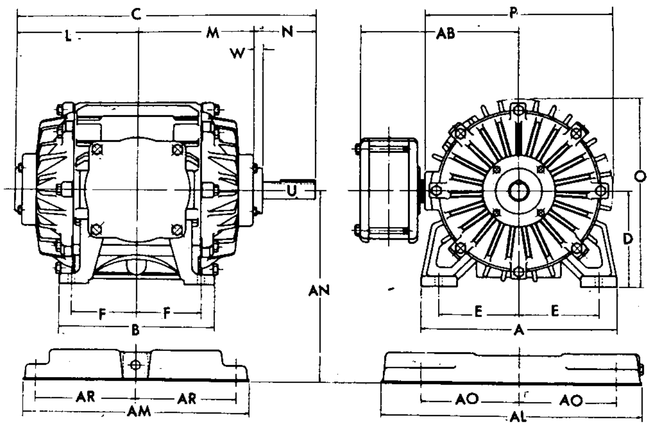


NON-VENTILATED



DIMENSIONS IN INCHES

Frame	Weight* (1)	Weight* (2)	Key	A	B	C (1)	C (2)	D	E	F	L (1)	L (2)	M	N	O	P	U	W	AB	AL	AM	AN	AO	AR
203	110	....	3/16 3/16 1⅜	9¾	6¾	13⅞	...	5	4	2¾	5¾	...	5⅝	2½	9¾	9½	.750	¼	8⅞	14	11	6¾	5	4¾
204	120	....	3/16 3/16 1⅜	9¾	7¾	14⅞	...	5	4	3¼	6¼	...	6⅛	2½	9¾	9½	.750	¼	8⅞	14	12	6¾	5	5¼
224	160	170	¼ ¼ 2	10¾	8¼	16⅝	18½	5½	4½	3⅜	6¾	8⅝	6⅝	3¼	10 13/16	10⅝	1.000	¼	9⅛	15½	12¼	7¼	5½	5⅜
225	170	180	¼ ¼ 2	10¾	9	17⅜	19¼	5½	4½	3¾	7⅛	9	7	3¼	10 13/16	10⅝	1.000	¼	9⅛	15½	13	7¼	5½	5¾
254	220	250	¼ ¼ 2⅜	11¾	10	20	22 1/16	6¼	5	4⅛	8¼	10 5/16	8⅛	3⅝	12	11½	1.125	¼	9½	17¾	15⅛	8¼	6¼	6⅝
284	....	320	¼ ¼ 2¾	12¾	11¾	..	24¾	7	5½	4¾	..	11½	9¼	4	13¼	12½	1.250	¼	10⅛	19¾	16⅞	9	7	7½
324	....	430	⅜ ⅜ 3¾	14¾	12¾	..	28¼	8	6¼	5¼	..	12⅞	10¼	5⅛	15⅝	15¼	1.625	¼	12½	22¾	19¼	10½	8	8½
326	....	470	⅜ ⅜ 3¾	14¾	14¼	..	29¾	8	6¼	6	..	13⅝	11	5⅛	15⅝	15¼	1.625	¼	12½	22¾	20¾	10½	8	9¼
364	....	800	½ ½ 4¼	17½	14	..	31⅛	9	7	5⅝	..	14	11¼	5⅞	18½	19	1.875	¼	14 1/16	25½	20½	11½	9	9⅛
364-S	....	800	⅜ ⅜ 1⅞	17½	14	..	28¾	9	7	5⅝	..	14	11¼	3½	18½	19	1.625	¼	14 1/16	..	..	..	..	..
365	....	875	½ ½ 4¼	17½	15	..	32⅛	9	7	6⅛	..	14½	11¾	5⅞	18½	19	1.875	¼	14 1/16	25½	21½	11½	9	9⅝
365-S	....	875	⅜ ⅜ 1⅞	17½	15	..	29¾	9	7	6⅛	..	14½	11¾	3½	18½	19	1.625	¼	14 1/16	..	..	..	..	..
404	....	1050	½ ½ 5	19½	15¼	..	34⅜	10	8	6⅛	..	15¼	12½	6⅝	20⅜	20⅝	2.125	¼	15 1/16	28½	22	13	10	9⅞
404-S	....	1050	½ ½ 2	19½	15¼	..	31¾	10	8	6⅛	..	15¼	12½	4	20⅜	20⅝	1.875	¼	15 1/16	..	..	..	..	..
405	....	1125	½ ½ 5	19½	16¾	..	35⅞	10	8	6⅞	..	16	13¼	6⅝	20⅜	20⅝	2.125	¼	15 1/16	28½	23½	13	10	10⅝
405-S	....	1125	½ ½ 2	19½	16¾	..	33¼	10	8	6⅞	..	16	13¼	4	20⅜	20⅝	1.875	¼	15 1/16	..	..	..	..	..
444	....	1400	⅝ ⅝ 5½	21½	17½	..	39⅝	11	9	7¼	..	17¾	14¼	7⅝	22⅝	23¼	2.375	½	16 5/16	31	24¼	14	11	11
444-S	....	1400	½ ½ 2¾	21½	17½	..	36¾	11	9	7¼	..	17¾	14¼	4¾	22⅝	23¼	2.125	½	16 5/16	..	..	..	..	..
445	....	1600	⅝ ⅝ 5½	21½	19½	..	41⅝	11	9	8¼	..	18¾	15¼	7⅝	22⅝	23¼	2.375	½	16 5/16	31	26¼	14	11	12
445-S	....	1600	½ ½ 2¾	21½	19½	..	38¾	11	9	8¼	..	18¾	15¼	4¾	22⅝	23¼	2.125	½	16 5/16	..	..	..	..	..
504-U	....	1900	¾ ¾ 7¼	24½	21	..	44⅛	12½	10	8	..	19	16¼	8⅞	24½	24½	2.875	¼	19½	34½	27¼	16	12½	12½
504-S	....	1900	½ ½ 2¾	24½	21	..	39¾	12½	10	8	..	19	16¼	4½	24½	24½	2.125	¼	19½	..	..	..	..	..
∅504-S	....	1900	½ ½ 2¾	24½	21	..	39¾	12½	10	8	..	19	15 9/16	5 3/16	24½	24½	2.125	15/16	19½	..	..	..	..	..
505	....	2100	¾ ¾ 7¼	24½	23	..	46⅛	12½	10	9	..	20	17¼	8⅞	24½	24½	2.875	¼	19½	34½	29¼	16	12½	13½
505-S	....	2100	½ ½ 2¾	24½	23	..	41¾	12½	10	9	..	20	17¼	4½	24½	24½	2.125	¼	19½	..	..	..	..	..
∅505-S	....	2100	½ ½ 2¾	24½	23	..	41¾	12½	10	9	..	20	16 9/16	5 3/16	24½	24½	2.125	15/16	19½	..	..	..	..	..

(1) Non-ventilated. (2) Fan-cooled. *Approximate shipping weight in pounds—bare motor. ∅For 75, 100 hp, 3600 rpm only, which have sleeve bearings.

Above dimensions are for preliminary use. For construction purposes obtain certified dimension sheets from your Allis-Chalmers office or distributor.

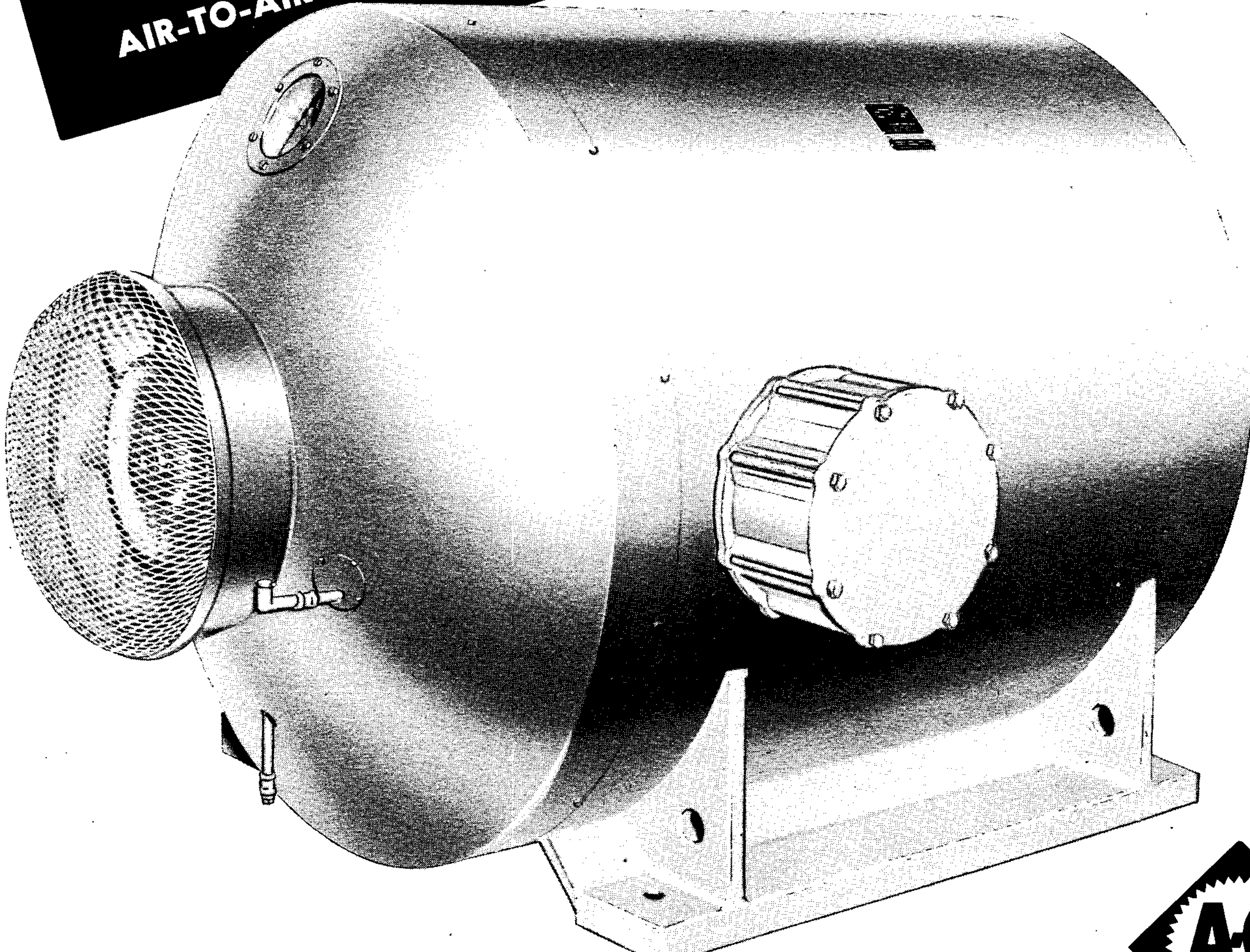
ALLIS-CHALMERS

Hp	Synchronous Rpm 3600	1800	1200	900	720	600
40						
50						
60						
75						
100						
125						
150						
200						
250						
300						
350						
400						
450						
500						
600						
700						
800						

ALLIS-CHALMERS

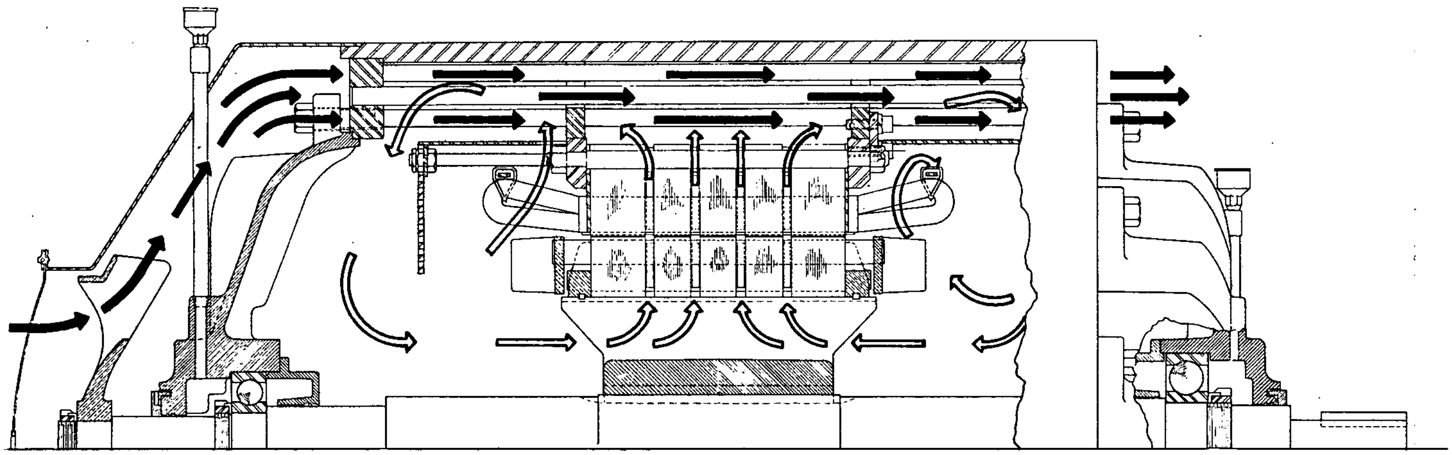
Totally-Enclosed Fan-Cooled Motors

WITH TUBE-TYPE AIR-TO-AIR HEAT EXCHANGERS



Standard — Type AZ   Explosion-Proof — Type AZZ

A-C ALLIS-CHALMERS



Here is how these *tube-type* motors are cooled. Solid arrows show external air flow, and open arrows show internal air circulation.

ALLIS-CHALMERS builds a complete line of polyphase motors—all backed by over a half century of electrical manufacturing experience. Recognizing the need for a more efficient means of heat transfer in large totally-enclosed fan-cooled motors, Allis-Chalmers developed a tube-type air-to-air heat exchanger construction.

Since its introduction in 1946, this TEFC motor design has proved itself under severe operating conditions in numerous oil field and refinery, central station auxiliary, and general industrial applications—both indoors and out.

Types and Ratings

These TEFC motors are built in *standard* and *explosion-proof* designs. The standard motors are for applications without explosion hazards but requiring protection of the windings from dust, dirt, acid fumes, etc. Explosion-proof machines are available — *with Underwriters' labels* — for the following National Electrical Code classifications:

Class I Group D — For atmospheres with flammable gases presenting no greater hazard than high test gasoline vapor and air mixture.

Class II — For atmospheres with combustible dust as follows: Group F — Carbon black, coal, coke.
Group G — Grain.

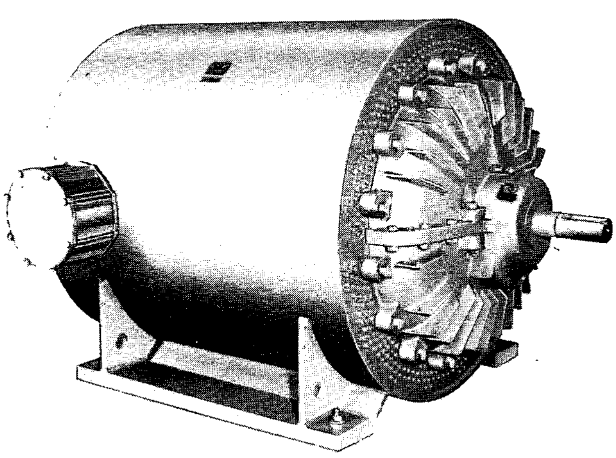
Standard Type AZ and explosion-proof Type AZZ squirrel-cage induction motors are available in the 60-cycle ratings shown by the chart on the cover page. Most of the ratings are available for all standard voltages from 208 to 2300 volts.

TEFC motors larger than those listed are available in similar designs, smaller ratings in other designs.

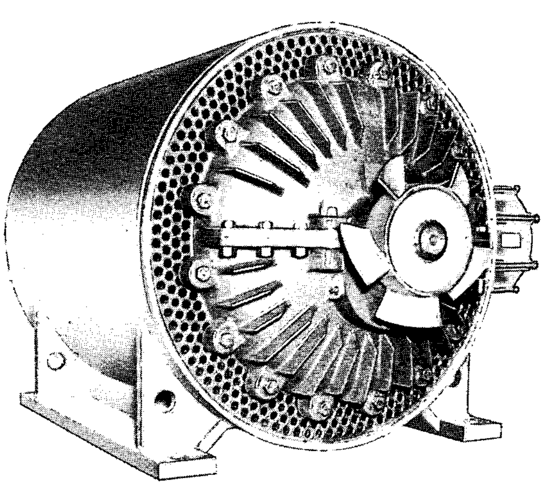
Construction

The general design and construction features of these tube-type heat exchanger motors are shown by the illustrations on the following pages. To suit specific application requirements and bearing preferences, Allis-Chalmers builds these motors with differing design details in accordance with the six general classifications illustrated on the page headed "Types of Construction."

Copper tubes and aluminum external fans are normally supplied for all types, but other materials can be used for these parts when atmospheric conditions so require. Standard temperature rating is 55 C continuous, with Class A insulation, but 40 C rise or Class B insulated motors can be furnished for ambient temperatures exceeding 40 C. Motors are available in vertical construction with NEMA Type P bases.



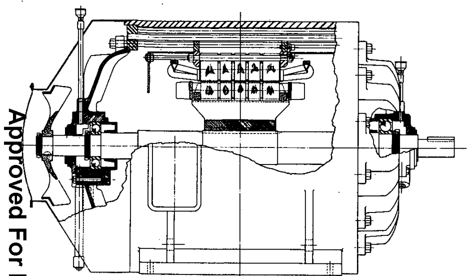
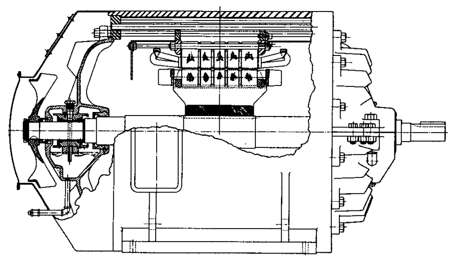
Coupling end view of explosion-proof motor shown on cover. For types of construction available (standard and explosion-proof), see facing page.



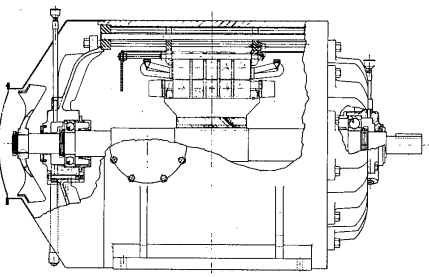
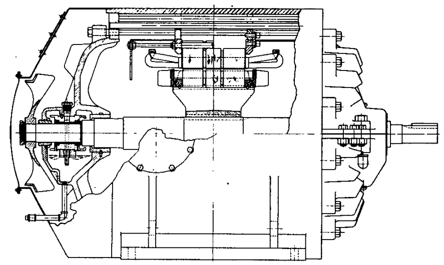
High-speed explosion-proof motor with fan housing removed shows front bearing end shield and arrangement used for mounting the external fan.

TYPES OF CONSTRUCTION

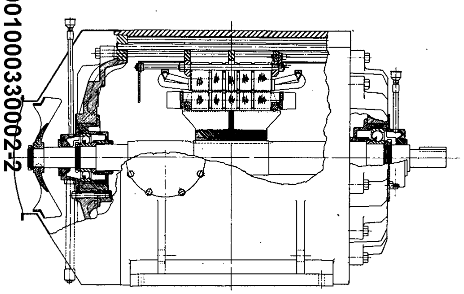
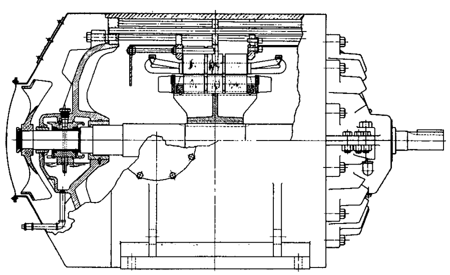
Ball Bearing **Sleeve Bearing**

Standard —Type AZ — For Non-Hazardous Locations

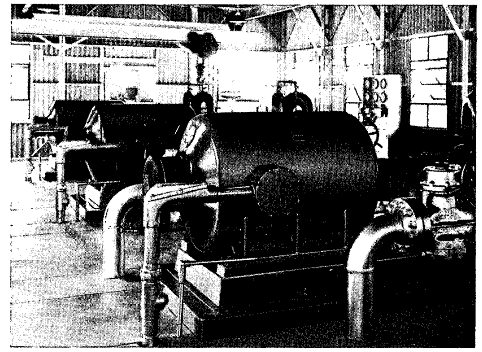
Explosion-Proof —Type AZZ — For Class II Group F and G Locations

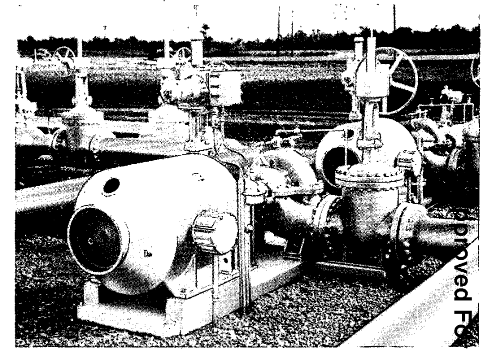
Explosion-Proof —Type AZZ — For Class I Group D Locations

For Typical Construction Features
Lift Page

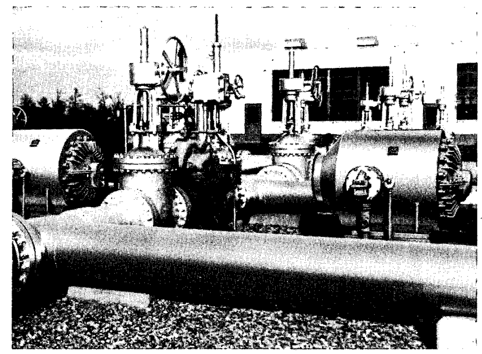
PROVED IN OPERATION



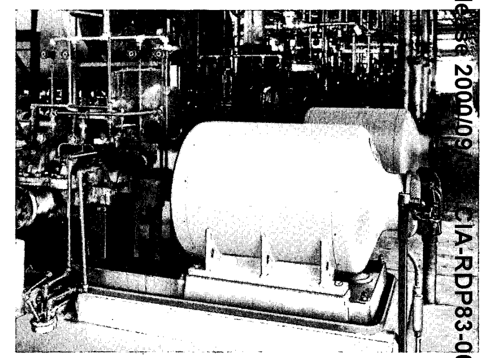
Three 400-hp explosion-proof motors in oil pipe-line station.



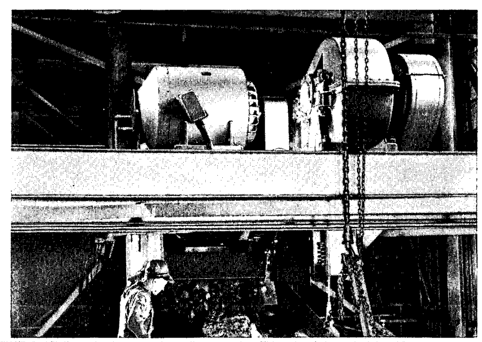
Two 150-hp explosion-proof motors on oil line booster pumps.



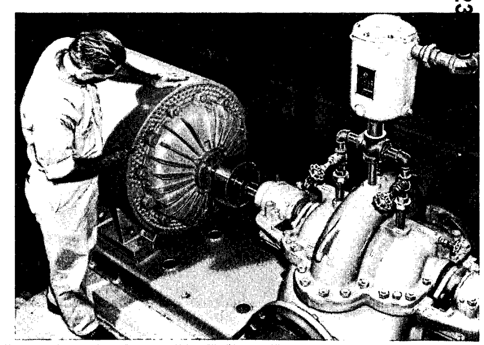
Booster pump station with two 200-hp explosion-proof motors.



Petroleum processing plant pump room with 350-hp AZZ motors.



Main conveyor in coal plant is driven by a 100-hp AZ motor.



This 125-hp AZ motor is used in a chemical processing plant.

ALLIS-CHALMERS

MILWAUKEE 1, WISCONSIN

Approved For Release 2000/09/01 : CIA-RDP83-00423

TYPICAL CONSTRUCTION FEATURES

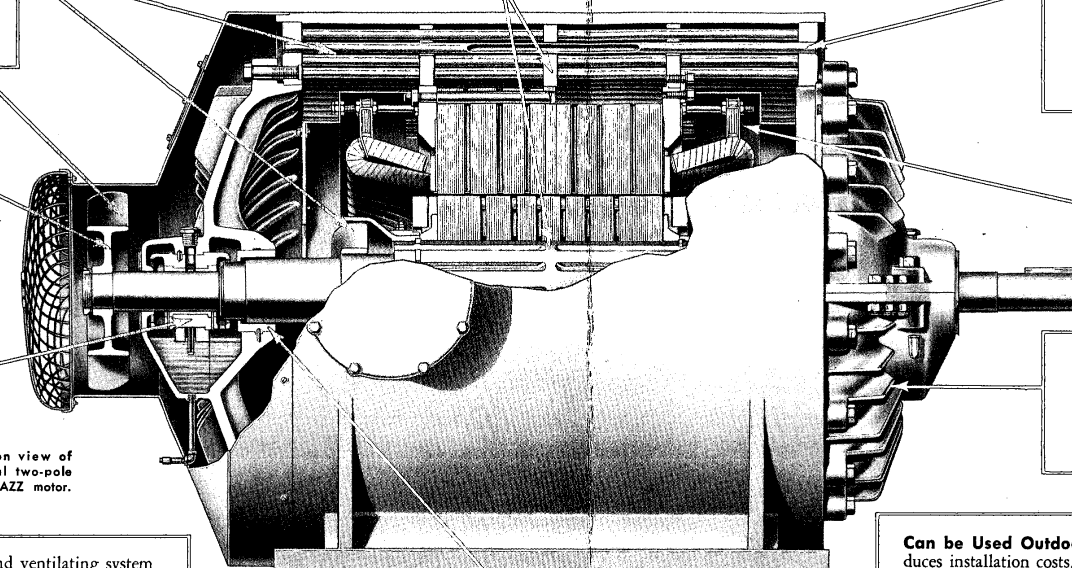
Simple Ventilating System — Internal fans circulate air in closed circuit within motor, convey heat to nest of tubes around stator. External fan blows outside air through tubes to exhaust heat.

Ample number and circumferential distribution of heat exchanger tubes combine with full internal air circulation to provide efficient, uniform cooling. (See diagram at left.)

External Fan — Keyed to shaft, protected and enclosed by heavy sheet steel housing. Non-sparking material used on all explosion-proof motors. Air intake is grid protected. Fans are directional for speeds of 1500 rpm and higher.

Choice of Bearings — Ball bearings with provision for in-service lubrication are standard for most ratings. Sleeve bearings can be supplied for all ratings and are standard for speeds of 3000 rpm and higher. Sleeve bearing motors ordered for coupled service are furnished with split end shields and bearing bushings. Ball bearings are housing mounted—except for Class I Group D service, for which cartridge mounting is used.

Compartmentalized — Stator yoke and core and rotor shaft or spider and core are built to divide interior into two compartments for Class I Group D service. Tests prove this prevents excessive pressures if internal explosions occur. Interchange of air through air gap is negligible.



Section view of typical two-pole Type AZZ motor.

Tubes Stay Clean — Smooth interior of tubes plus external fan action keeps tubes free of dust and dirt. Air flow remains unobstructed. For unusual conditions, tubes are easily cleaned with ramrods — without dismantling motor — even with motor running. There are no pockets to trap water or other condensate.

Copper tubes are generally used for both standard and explosion-proof motors. However, for atmospheres which destructively attack copper, other tube materials can be supplied.

Dirt Stays Out — All internal parts, including stator laminations, are totally enclosed. They remain clean. Harmful substances in atmosphere do not affect operation or life of motor.

Cast-Iron End Shields — Heavy cast-iron end shields have internal and external ribs for added strength and heat radiation, and are securely bolted to yoke. Inspection plug for checking oil ring operation has lucite cap.

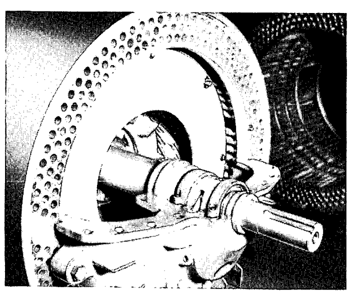
Conventional Design — Only the enclosing parts and ventilating system are special. Electrical parts and bearings are the same as in standard open motors. The stator yoke is fabricated from heavy plate steel. Removable as a unit, the stator core assembly is built up of high-grade silicon steel laminations. Stator coils are form wound. Rotor construction is suited to the speed and size of the motor, using brazed cage windings for long, trouble-free operation. All ratings are suitable for full-voltage starting.

Flame Arrester — In sleeve bearing motors for Class I Group D locations, a non-sparking arrester cools flame of internal explosions to prevent propagation to bearing cavity.

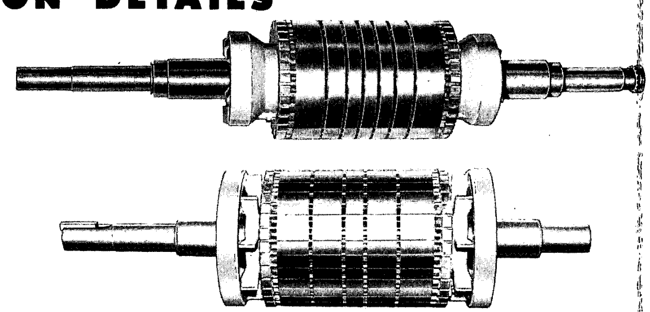
Can be Used Outdoors — Design affords natural outdoor protection, reduces installation costs. Cooling tubes of copper or other non-corroding material withstand fog, rain, snow, salt, coal dust, soot, alkalies, and mild acids in the air — even during prolonged shutdowns.

Accessibility — Cleaning, if necessary, can be done with motor in operation. Even complete disassembly is simple. Since all motors breathe, a plug will, if specified, be provided at bottom of yoke for removal of any condensate.

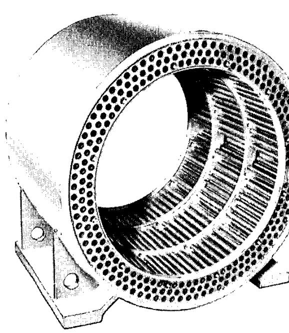
CONSTRUCTION DETAILS



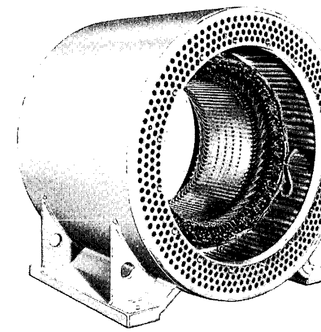
Lower speed motor partly dismantled to show details of sleeve bearing and flame barrier.



Rotor assemblies shown with internal fans but without external fans. Rotor at top is for two-pole (3600-rpm) motor, while bottom one is for lower speed motor.



Stator yoke construction used for standard and Class II Group F and G motors. Tubes are rolled and flared in yoke end plates.

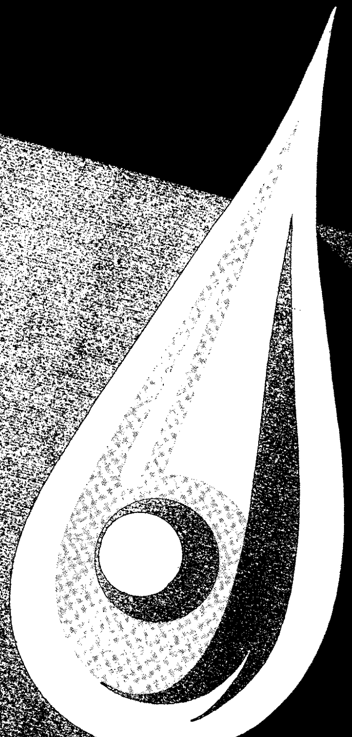


Wound stator for standard *tube-type* motor shows coil end lacing and core slot wedges used to secure the stator coils in the yoke.

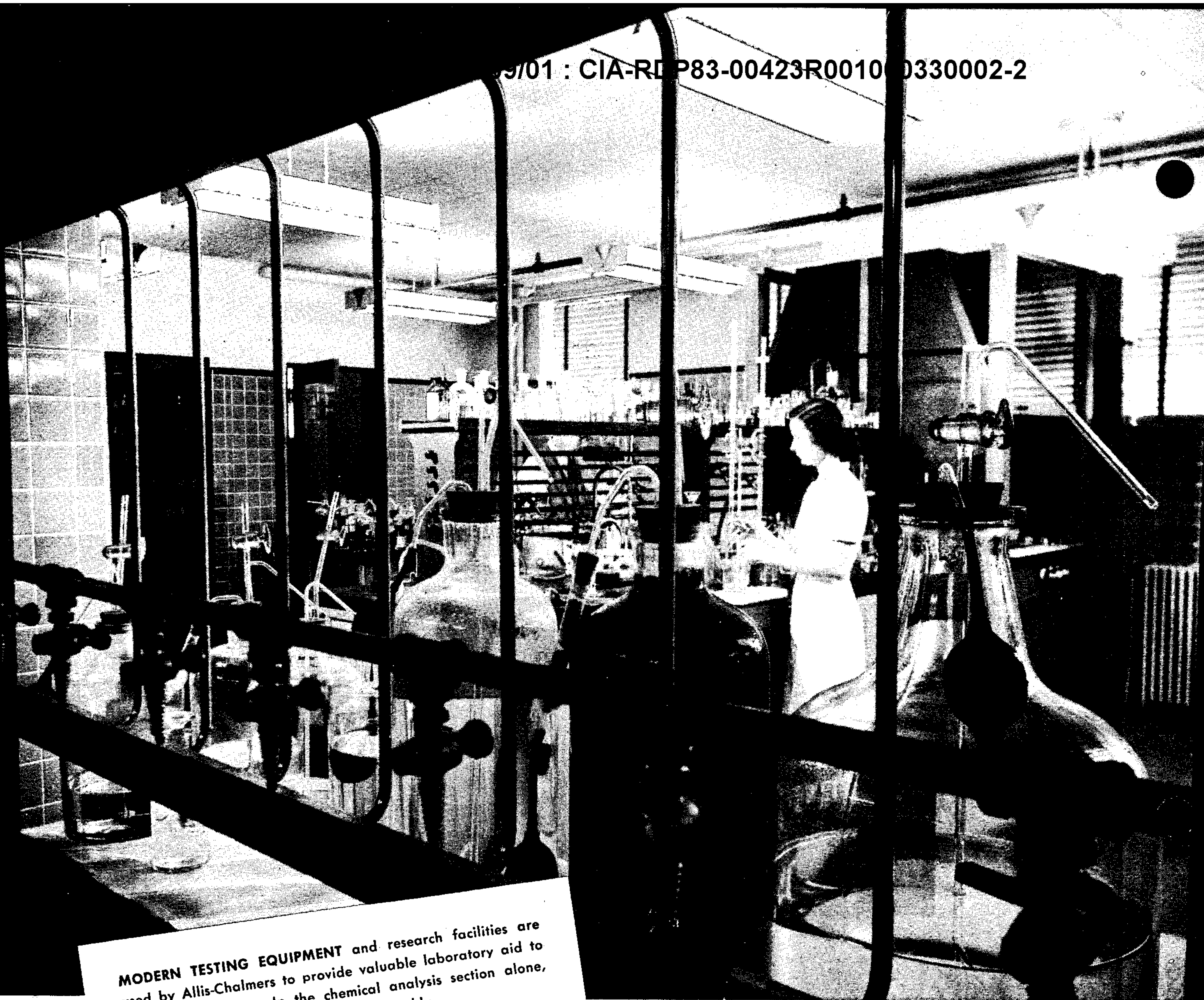
ALLIS-CHALMERS *Water*

CONDITIONING

Chemicals and Equipment



ANALYSIS INSTRUCTIONS AND PRICE



MODERN TESTING EQUIPMENT and research facilities are used by Allis-Chalmers to provide valuable laboratory aid to numerous industries. In the chemical analysis section alone, over 9000 determinations are made monthly.

Experienced power plant operators are aware that use of high grade fuel is not always the complete answer to maximum boiler efficiency . . . that the principles of combustion must be understood and intelligently applied if the "output over input" ratio is maintained at the peak. It should be equally apparent that the solution of a water treating problem will be found not only in properly selected water conditioning chemicals and equipment but in the control of their use as well.

The theory and practice of conditioning water for industrial use is beyond the scope of this booklet. Our primary purpose *here* is to describe the generally accepted methods of water analysis for guidance of plant operators. But interpretation of analytical results must be intelligently translated into control adjustments on the basis of type of treatment employed, available water supply, prevailing operating conditions and existing steam generation and power equipment.

Many years of experience in water conditioning work qualifies us as a reliable source of assistance in this field. We therefore solicit the opportunity of discussing such problems with you — without obligation on your part. The range of services available is indicated on p. 10 of this bulletin . . . and a convenient directory of A-C sales offices is on the back cover.

Water Conditioning Dept.

ALLIS-CHALMERS MFG. CO.

IMPORTANCE OF FEEDWATER CONTROL

THE TREATMENT of boiler water is similar to any other industrial or chemical process in that conditions must be controlled for best results. A treatment is designed primarily to produce certain chemical conditions in the boiler water. When these conditions are obtained the boilers will be scale-free, corrosion-free, and the boiler metal will not embrittle. The steam will also be free from boiler water salts and corrosive gases. It is not only necessary that proper chemicals should be chosen, but that control of their use should be checked regularly.

Usually there is a certain minimum of treatment which will prevent scale formation. If this minimum is greatly exceeded, foaming and priming will result and possibly caustic embrittlement. If the minimum is not maintained constantly, then scale formation will result. Proper control keeps the water conditions safely between these two extremes. Thus the super-heater, steam lines and prime movers are protected as well as the boilers.

The chemical condition of a boiler water is judged to be satisfactory or unsatisfactory according to the concentrations of the various boiler water salts.

TOO HIGH A HARDNESS will allow crystalline scale to form.

TOO HIGH AN ALKALINITY will cause foaming and priming.

HIGH CONCENTRATIONS of total dissolved solids may also cause dirty steam.

DISSOLVED OXYGEN will cause corrosion.

In order for an engineer to safely operate his boilers free from the dangers of improper treatment, he must know the proper ranges in which to maintain the concentrations of each boiler water constituent. These different ranges vary from plant to plant depending upon steam pressure, boiler design, boiler rating, steam demand and the nature of the feedwater.

The concentration of the boiler water constituents is determined by a series of simple titrations, the procedures for which are included in the following pages. The word *titrate* is a chemical term and consists in adding a measured quantity of a reagent to a sample of water, containing an "indicator", until some color change occurs. This color change, or, in case of a soap hardness titration, the formation of the permanent lather, is known as the *end point.*

The tests commonly made on boiler water include those for alkalinity, chlorides, hardness and sulfates. From the alkalinity tests, the concentrations of sodium hydroxide and sodium carbonate can be determined. This is necessary in order to make sure that the recommended ratios for the prevention of caustic embrittlement are being maintained and also for the prevention of scale. These same tests are made on treated water from a softener with the exception of the sulfate determination.

Dissolved oxygen tests are made on feedwater and on steam, but seldom on boiler water. Steam is frequently checked also for carbon dioxide, pH value, and sometimes for ammonia. These tests are all relatively simple and a knowledge of the proper procedure will enable any operator to maintain a better control of water conditions throughout the plant.

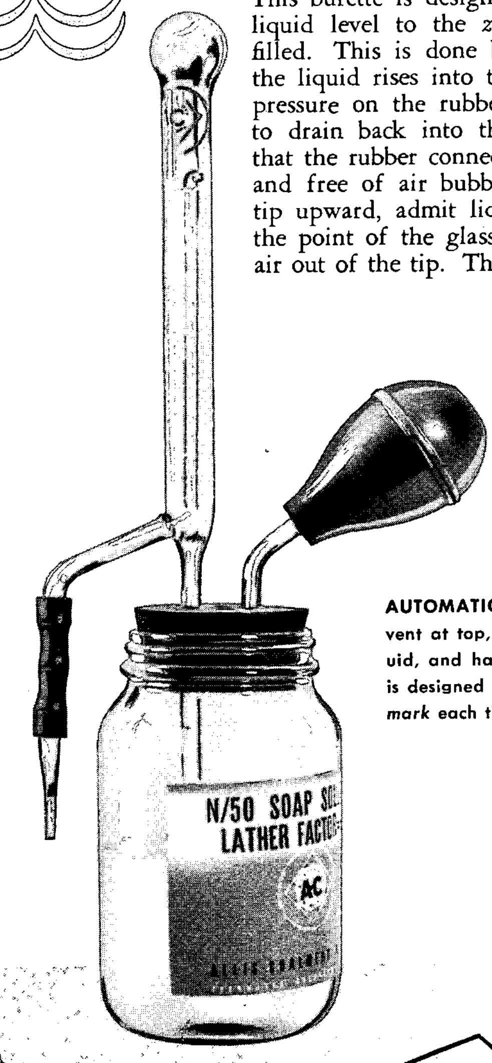
The tests, as outlined, have been taken from the work of the American Public Health Association, the Joint Feedwater Committee of the American Society of Mechanical Engineers, and the American Society for Testing Materials.

REGARDING CARE OF TESTING EQUIPMENT

It is important that all chemical testing apparatus be kept clean. Dirty and broken equipment promotes slovenly and careless testing. If bottles and glassware are thoroughly washed each time after using, the test kits will be maintained in first class condition. A cabinet for housing the glass-ware and solutions is helpful. Should the apparatus become coated with a thin white deposit, it may be cleaned by washing in an acid solution.

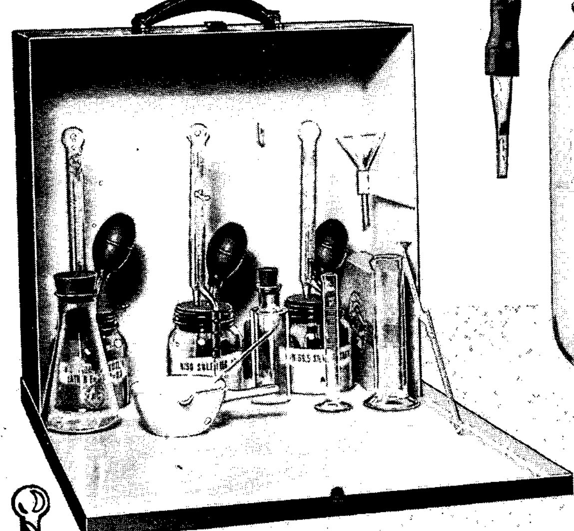
THE AUTOMATIC BURETTE

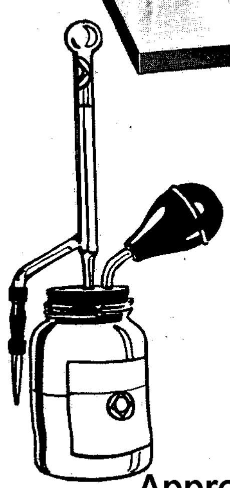
This burette is designed so as to automatically adjust the liquid level to the *zero mark* each time the burette is filled. This is done by squeezing the bulb. As soon as the liquid rises into the glass ball at the top, release the pressure on the rubber bulb and allow the excess liquid to drain back into the reservoir. Before using, be sure that the rubber connection and glass tip are full of liquid and free of air bubbles. Do this by inclining the glass tip upward, admit liquid by pinching the rubber tube at the point of the glass bead and allow the liquid to force air out of the tip. Then refill the burette to the zero mark.



AUTOMATIC BURETTE consists of graduated tube with air vent at top, rubber bulb with glass tube for pumping liquid, and handy drain tube for drop-by-drop testing. Unit is designed to *automatically* adjust liquid level to the zero *mark* each time burette is filled.

COMPLETE TEST KIT is available for making standard feedwater and boiler water tests. Component parts are conveniently mounted in attractive sheet metal case.

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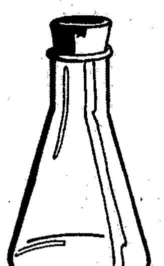
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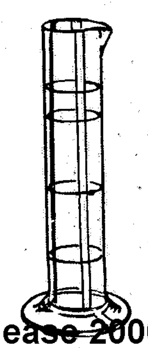
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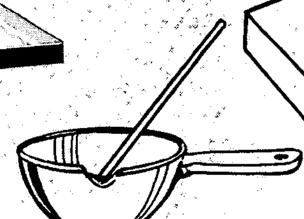
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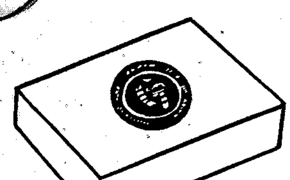
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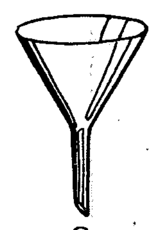

G

ILLUSTRATED HERE are several of the items contained in Allis-Chalmers' water conditioning test kit:

(A) Automatic Burette for accurate measuring of reagent
(B) 250-ml Erlenmeyer Flask with rubber stopper
(C) Graduated Cylinder, marked 58.3 — 50 — 29.15 — 14.575 ml.
(D) 150-ml Porcelain Casserole with glass stirring rod
(E) Box of Filter Paper, 12.5 cm
(F) Indicator Bottle with dropper
(G) Glass Funnel, 65-mm

OBTAINING SAMPLES

In order to secure accurate results, it is highly important that the operator obtain a representative sample of the water to be tested. In general, all water samples are to be titrated only after cooling to room temperature. Wherever suspended matter is present (i.e. sludge, mud, etc.) the sample should be filtered. Containers must be clean and should be thoroughly rinsed with the water to be tested before obtaining the final sample.

(a) Raw Water

Raw water should be distinguished from *feedwater*. The *raw water* meaning the actual water from the well, river, lake, etc; the *feedwater*, that entering the boiler, which is often composed of raw (or softened) water mixed with condensate. When running field tests on raw water, note precautions below as regards making the hardness test.

(b) Softened Water

The term *softened water* refers to water which has been subjected to some kind of external softening treatment, such as a lime and soda, phosphate, or a zeolite softener. In the case of lime and soda or phosphate softening, where filters are employed, samples should be taken following the filters — but not too soon after backwashing a filter.

(c) Feedwater

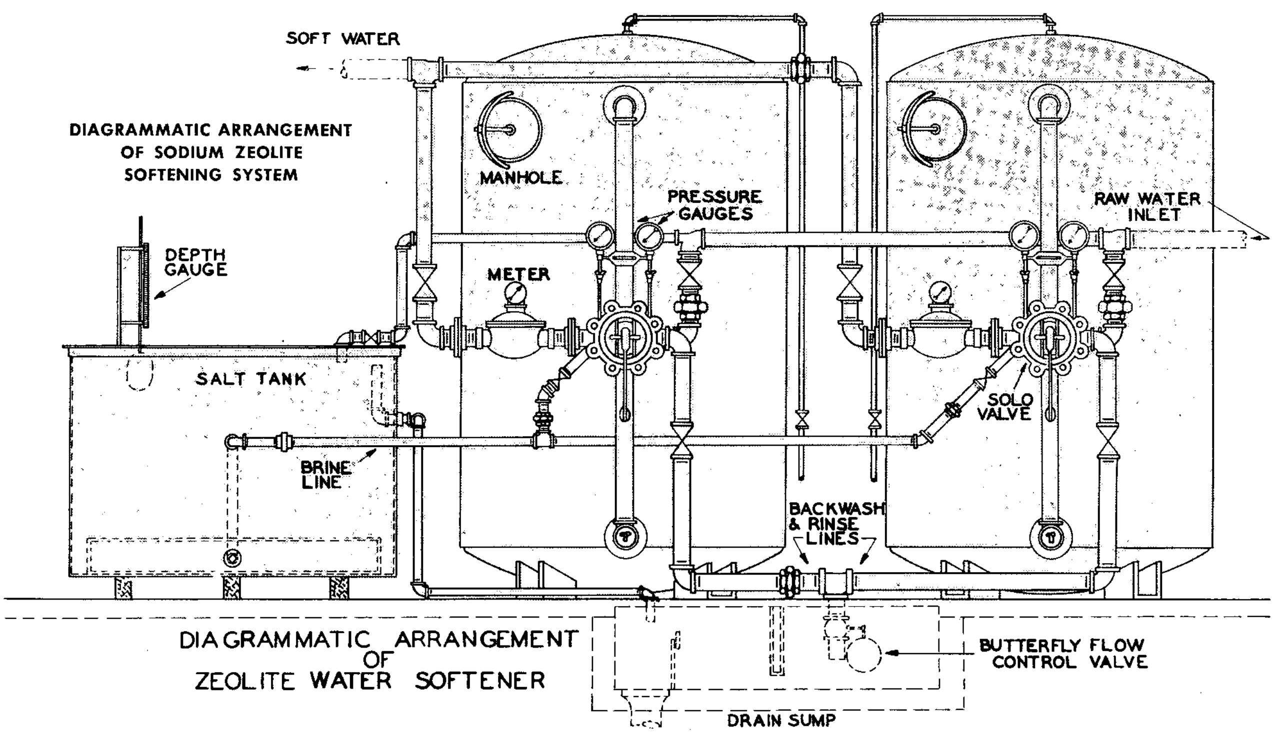
The term *feedwater* is used to describe that water actually entering the boiler such as might be sampled at the boiler feed pump. See remarks under (a) above.

(d) Boiler Water

Samples of boiler water require great care in sampling. If cooled under pressure by means of a cooling coil, they are more likely to be representative, since no concentration can take place by *flashing*. Lacking this, they should preferably be taken from a blow-down line or thirdly, from the water column. When the latter method is used, care must be taken to thoroughly blow down the water column immediately before sampling. If this is not done, the sample is likely to be diluted by condensation. Boiler water samples should be taken just before blowing down the boiler and in the case of internally treated boilers, just before adding treatment.

(e) Condensate Sample

A good quality of condensate is an *unbuffered* solution, which makes the pH value highly susceptible to change when small amounts of foreign matter are allowed to contaminate the sample. It is therefore important that containers in which condensate samples are to be collected be thoroughly and repeatedly rinsed with the water to be tested. (See also notes in reference to testing condensate samples for hardness.)



DIAGRAMMATIC ARRANGEMENT OF ZEOLITE WATER SOFTENER

Approved For Release 2000/09/01 : CIA-RDP83-00423R001000330002-2

REPORTING RESULTS

WITH EXCEPTIONS noted hereafter, when using standard reagent chemicals supplied by Allis-Chalmers Mfg. Co. and following the methods described herein, all results are expressed in terms of grains per gallon. To change to parts per million, multiply by 17.1. *Excepting in case of the sodium sulfate determination,* if results are required in parts per million, use 50 ml sample (instead of 58.3 ml) and multiply amount of standard reagent required by twenty. Also, if results are required in parts per hundred thousand, use 100 ml sample and read results direct. Use the following table for reference.

Results Expressed In	Full Sample ml	Multiply by	Half Sample ml	Multiply by	Quarter Sample ml	Multiply by
Grains per gallon	58.3	1	29.2	2	14.6	4
Parts per million	50	20	25	40	12.5	80
Parts per 100,000	100	1	50	2	25	4

H represents total hardness, in terms of calcium carbonate ($CaCO_3$) and is determined by the use of the standard soap solution or standard hardness titrating solution.

P denotes a portion of the alkalinity present, obtained by titrating with 50th normal sulfuric acid, using phenolphthalein indicator. Results are in terms of calcium carbonate.

M represents total alkalinity (sometimes indicated as **MO** alkalinity) and is obtained by titration with 50th normal sulfuric acid, using methyl orange indicator. Results are in terms of calcium carbonate.

Cl is the symbol for total chlorides expressed as sodium Chloride (NaCl).

SO_4 is the symbol for the sulfates present, in terms of sodium sulfate (Na_2SO_4), and is determined by the benzidine method or the barium nitrate titration method.

HANDY REFERENCE TABLES

WATER SOLUBILITY OF ANHYDROUS SALTS IN POUNDS PER GALLON

		Degrees Fahrenheit										
		32	50	68	86	104	122	140	158	176	194	212
Sodium Chloride	NaCl	3.0	3.0	3.0	3.0	3.0	3.1	3.1	3.2	3.2	3.2	3.3
Sodium Bicarbonate	$NaHCO_3$	0.58	0.68	0.80	0.85	1.0	1.2	1.3				1.6
Monosodium Phosphate	NaH_2PO_4	4.8	5.8	7.1	8.8	11.5	13.2	14.9	15.8	17.2	18.8	20.0
Disodium Phosphate	Na_2HPO_4	0.16	0.33	0.66	2	4.5	6.8	6.9	7.2	7.9	8.7	8.5
Trisodium Phosphate	Na_3PO_4	0.12	0.33	0.92	1.66	2.6	3.6	4.5		6.6		9.0
Tetrasodium Pyrophosphate	$Na_4P_2O_7$	0.25	0.33	0.52	0.82	1.10	1.5	1.8		2.5		3.5
Sodium Carbonate (Ash)	Na_2CO_3	0.58	1.0	1.8	3.2	4.0		3.8		3.8		3.8
Sodium Sulfate	Na_2SO_4	0.40	0.7	1.6	3.4	4.0	3.8	3.8		3.65		3.55
		0	10	20	30	40	50	60	70	80	90	100
		Degrees Centigrade										

$$\text{Percent Blowdown} = \frac{\text{NaCl in Mixed Feedwater}}{\text{NaCl in Boiler Water}} \times 100$$

$$\text{Percent Makeup} = \frac{\text{NaCl in Mixed Feedwater}}{\text{NaCl in raw Water}} \times 100$$

$$\text{A.S.M.E. Embrittlement Ratio} = \frac{\text{Sodium Sulfate in Boiler Water}}{\text{Total Alkalinity ("M") in boiler water}}$$

STANDARDS (U.S.) COMMONLY USED IN WATER CONDITIONING

1 grain per gallon (gpg) = 17.1 parts per million (ppm)
1 part per million = 0.0583 grain per gallon
1 part (pound) per million = 0.00833 pound per 1000 gallons
1 part per million dissolved oxygen = 0.7 ml per liter
1 ml per liter dissolved oxygen = 1.43 parts per million
1 milliliter (ml) = 1 cubic centimeter (cc)
1 pound = 7000 grains = 0.4356 kilogram
1 gallon saturated salt brine weighs 10 lb contains approximately 2.5 lb salt

1 gallon water = 0.1337 cu ft = 231 cu in.
1 gallon water = 3.785 liters = 0.8327 Imperial gallon
1 gallon water = 8.34 pounds
1 cubic foot water = 7.48 gallons = 62.47 pounds
Pounds water per hour ÷ 500 = gallons per minute
1 foot water @ 60° F = 0.433 psi pressure = 0.8826 in. mercury
1 psi pressure = 2.31 ft water = 2.036 in. mercury

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TEST PROCEDURE

SOAP HARDNESS — In terms of Calcium Carbonate

(a) Boiler Water . . . or softened water.

1. If the sample is cloudy, filter it.

2. Where estimated hardness (in grains per gallon) is:
0- 8 use 58.3 ml sample
8-16 use 29.2 ml sample (half sample)
16-32 use 14.6 ml sample (quarter sample)

3. When fractions of a sample are used, make up to 58.3 ml with distilled water or pure condensate.

4. Place prepared sample in the *shaker* bottle and add standard soap solution from the burette. Make these additions of soap slowly and only 0.1 or 0.2 ml. at a time, shaking the stoppered bottle after each addition of soap. The end point is reached when a permanent lather is formed which does not break in 3 to 5 minutes. The total number of ml of soap used to obtain the final lather, minus the lather factor, represents total hardness **(H)**.

Lather factor represents that quantity of Standard Soap Solution required to obtain a permanent lather (the *end point*) when added to alkaline, zero hard water. All Standard Soap solutions have this *lather factor* plainly marked on the label which is affixed to the bottle.

NOTE: If ½ or ¼ samples are used, subtract the lather factor from the number of ml of soap used, before multiplying by two or four respectively.

(b) Raw Water . . . or condensate.

Note steps 1, 2, and 3 above. For (4) substitute the following:

5. Place the sample in the *shaker* bottle. Add a few drops of phenolphthalein, and if no pink color develops, add slowly standard sodium hydroxide solution until a faint pink color just remains. Then continue with the titration as noted in (4) above.

NOTES: A raw water sample will usually exhibit what is known as a *Ghost Point* **(GP)**. This is a lather of finer texture than the final lather obtained as the *end point,* but the lather obtained at the *ghost point,* will break down upon addition of more soap solution. The lather obtained at the final *end point* is more coarse and tends to stick to the sides of the bottle in bunches or bubbles. The amount of soap, minus the lather factor, used to form the *ghost point* **(GP)** represents the amount of hardness due to the calcium salts in the water. That used to obtain the final "end point" represents the amount of hardness due to the calcium salts plus the magnesium salts present.

(Inclosure describes "S & B" method for determining total hardness in water.)

P and M ALKALINITY . . . In terms of Calcium Carbonate

6. Measure 58.3 ml of the filtered sample into the titrating dish. If alkalinity readings are judged to be high, use fractional samples, multiplying results by two or four according to the size of sample used.

7. Add two or three drops of phenophthalein indicator. If no color develops, record **P** as zero and proceed with step 10.

8. Fill acid burette with standard sulfuric acid to zero mark and while constantly stirring add the acid to water sample slowly until pink color disappears.

9. Record the number of ml of acid used as the **P** alkalinity.

10. To the same sample add two drops of methyl orange indicator (or one drop of methyl purple indicator). Without refilling the burette, continue to add acid, while stirring, until a color change takes place. Methyl orange changes from canary yellow to orange. Methyl purple changes from green to purple.

11. Record the total number of ml of acid used as the **M** reading . . . or total alkalinity.

B ALKALINITY . . . Barium Chloride Method

This alternate method is used for boiler samples only when organic matter is present in considerable quantity. Such waters are usually colored. The color change for the **M** titration is difficult to observe and the results are likely to be too high. In order to eliminate the error introduced by the organic matter, the following method is to be substituted for the **M** titration.

12. Proceed as noted under 6 above.

13. Add 10 ml of barium chloride solution (10%) and a few drops of phenolphthalein indicator. A pink color should develop.

14. Then titrate with the standard sulfuric acid as in 8 above. The reappearance of the pink color upon standing should be disregarded.

15. Record the number of ml of acid used as the **B** reading: It represents the *hydroxide* alkalinity, in terms of calcium carbonate.

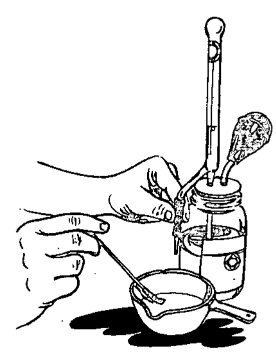
If it is required to obtain the hydroxide alkalinity *and* the carbonate alkalinity, a **P** reading must be made as noted in 6 through 9 above in addition to the **B** reading . . . then, 2 **(P-B)** = carbonate alkalinity only.

CHLORIDE . . . In terms of Sodium Chloride

16. Pour the 58.3 ml of prepared sample into the titrating dish. If chlorides are judged to be high, use a fractional sample, and multiply the number of ml of silver nitrate used by two or four, according to the size of the sample.

17. Add 2 drops of phenolphthalein indicator. If *no* pink color develops, disregard this portion of the test, and proceed to 19 below.

18. Add standard sulfuric acid until the pink color just disappears.



19. Add 1 dropper of potassium chromate indicator; fill the burette with standard silver nitrate and titrate until the color of the sample first turns to a permanent slight reddish tinge. This is the end point.

20. The amount of silver nitrate required to cause this color change, minus the blank, is recorded as chlorides, in terms of sodium chloride. The amount of the blank is determined by taking a 58.3 ml sample of distilled water, adding the potassium chromate and titrating to a color change with standard silver nitrate. The ml required for this color change represents the *blank* and is to be substracted from subsequent chloride determinations. The blank will vary with individuals, depending upon the intensity of color change used as the end point.

SULFATES . . . In terms of sodium sulfate

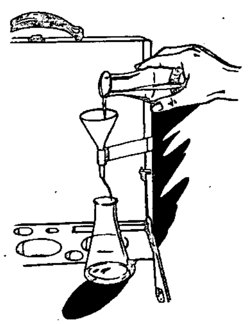
(a) Benzidine Method

21. If the estimated sulfates are between

0-100 grains per gallon, use a 58.3 ml sample
100-200 grains per gallon, use a 29.2 ml sample
200-400 grains per gallon, use a 14.6 ml sample

When using fractional samples, make up to 58.3 ml with distilled water.

22. Place sample in a 250 ml Erlenmeyer flask and add 10 ml of Benzidine Solution. Mix by giving the flask a swirling motion. Allow to stand 5 or 10 minutes. If sulfates are present, a whitish, shimmery precipitate will be formed.



23. Filter the precipitate through a tight filter paper. If the filtrate is cloudy, pass it through the paper again. To determine if all sulfates have been precipitated, add a few drops of benzidine to the filtrate. If more precipitate appears, filter it through the paper again.

24. After completing the filtration, the precipitate on the filter paper should be thoroughly washed to free it from any excess benzidine solution. To do this, rinse the emptied flask — the one which contained the filtrate — with distilled water, and use this rinse water to wash the precipitate. Allow the wash water to drain out of the funnel completely, before adding more. Repeat this washing procedure at least three times, pouring the wash water around the top of the filter paper, near the rim of the funnel, in order to wash the entire surface of the paper.

25. After the last washing has completely drained from the funnel, carefully remove the filter paper and place it in a clean flask containing about 50 ml of distilled water. Add a few drops of phenolphthalein indicator, place a rubber stopper in the flask and shake vigorously until the paper is disintegrated.

26. Titrate with standard sodium hydroxide solution from a burette until a pink color develops which will remain for at least ½ minute. Impart a swirling motion to the flask during titration and at intervals place the stopper in the flask and shake the contents well to separate the paper. This will permit a thorough mixture of the sodium hydroxide with the disintegrated paper.

27. If a 58.3 ml sample of water was used, multiply the number of ml of sodium hydroxide used by ten. This represents the sodium sulfate content in grains per gallon.

If a half sample was used, multiply by 20; if a ¼ sample, multiply by 40.

If sample contains less than 10 gpg of sodium sulfate, use a double sample (116.6 ml) and divide results by 2, then multiply by ten.

NOTES: If more than 10 ml of sodium hydroxide is required to get the color change, start over and use a smaller sample. If sample contains more than 400 gpg of sodium sulfate, use ¼ sample and add 20 ml of benzidine instead of 10 ml.

For results in parts per million, use 50 ml of sample . . . or fraction thereof, making up to 50 ml with distilled water. If a 50 ml sample was used multiply the number of ml of sodium hydroxide used by 200 . . . if a 25 ml sample was used, multiply the sodium hydroxide required by 400 . . . if a 10 ml sample was used, multiply the sodium hydroxide required by 1000, etc.

(b) Barium Nitrate Method

28. In a pipette measure a 25 ml sample of boiler water and transfer to an Erlenmeyer titrating flask. Add 2 or 3 drops of phenolphthalein indicator. Then titrate with 10th normal nitric acid drop by drop until the pink color just barely disappears.

29. Then add 25 ml of alcohol and one or two dippers of "A-C sulfate indicator". The solution should be colored yellow by this indicator.

30. Titrate with standard barium nitrate solution until the yellow color is just changed to a rose red. The number of ml of barium nitrate required multiplied by 5 equals the sodium sulfate present, expressed in grains per gallon.

NOTES: *Excess phosphate* (PO_4) in the boiler water interferes with this test if it is more than 75 parts per million. This slight interference may be minimized by diluting the original sample with pure distilled water so that the final phosphate concentration is below 75 parts per million. If the sample is diluted, be sure to compensate for it in the sulfate reading. Thus, if one part of boiler water is mixed with one part of distilled water in order to reduce the phosphate below 75 parts per million, then 25 ml of this diluted mixture is used for the barium nitrate titration, and the amount of barium nitrate used should be multiplied by 10 instead of 5.

During titration, the alcohol concentration should be kept at about 50%. If the total amount of barium nitrate used exceeds 10 ml, then *another* 10 ml of alcohol should be added.

If the total amount of barium nitrate required exceeds 10 ml discard the sample and make a new test, using a smaller sample of boiler water, made up to 25 ml with distilled water.

If a 10 ml sample is used, the number of ml of barium nitrate multiplied by 12.5 equals the sodium sulfate present in grains per gallon; if a 5 ml sample is used, the amount of barium nitrate used multiplied by 25 equals the sodium sulfate present, in grains per gallon.

The presence of calcium and magnesium interferes with the end-point, so this method cannot be used in determining sulfates in raw water samples.

SULFITE . . . In terms of sodium sulfite

Iodide-Iodate Method

This test is based on titrating the sulfite in a sample with a standard potassium iodide-iodate solution. Iodine is set free when sulfite has been completely oxidized, giving a blue color in the presence of starch. The appearance of a blue color is the end point.

31. The sample should be freshly drawn with as little contact with air as possible and *not* filtered, although cooled.

32. Place 0.5 ml (about 10 drops) of concentrated hydrochloric acid in a 150 ml casserole and add 100 ml of the sample. Add 1 ml (about 20 drops) of starch solution to the sample, with stirring, but not too violently. Titrate with standard iodide-iodate solution to the appearance of a permanent blue color.

33. Using a 100 ml sample, the sulfite in ppm as Na_2SO_3 is equal to the ml of potassium iodide-iodate multiplied by five.

FREE CARBON DIOXIDE (CO_2)

To avoid undue exposure to the air, samples for this test should be carefully taken and the test must be made as

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quickly as possible. Collect the sample as near to room temperature as is practical. This can be done by means of a cooling coil.

Measure 50 ml of sample into a white porcelain dish and add several drops of phenolphthalein indicator. If a pink color develops, no free CO_2 is present.

If no pink color develops, immediately add standard sodium carbonate solution from the burette until the pink color persists for 5 seconds. Disregard the rapid disappearance of the color. Each ml of standard sodium carbonate solution is equal to 10 parts per million of carbon dioxide as CO_2.

NOTES: If the CO_2 content is less than 5 parts per million, the titration should be carried out in a 100 ml graduate. After each addition of standard sodium carbonate, the solution should be mixed by stoppering the cylinder and inverting it two or three times. When a faint pink color (stable for 5 seconds) is observed by viewing the solution down through the length of the cylinder, the end point has been reached.

DISSOLVED OXYGEN (Modified Schwartz-Gurney Method)

This method is known as the bi-iodate modification of the Schwartz Gurney Method. The method involves collecting three samples simultaneously and the fixing and titration of two different sized samples. The subtraction of one titration from the other cancels out errors such as those due to the starch indicator, oxygen in the reagents and other reducing or oxidizing substances.

Materials and solutions:

Manganous sulfate solution	One 500 ml. ground glass stoppered bottle
Alkaline potassium iodide solution	
50% sulfuric acid solution	One 600 ml. white titrating dish
Sodium thiosulfate .00313N	Starch solution
Potassium bi-iodate .00313N	Four 2 ml. pipettes
Copper cooling coil with control valve and tip	One 10 ml. burette
Gum rubber tubing	One stirring rod
Two 250 ml. ground glass stoppered bottles	One sampling manifold

Collection of samples:

Special precautions are required in the collection of the sample and manipulation thereafter in order to prevent contamination from oxygen in the atmosphere and impurities in the sampling system. The collection bottles must be properly flushed and the temperature of the sample must be 65° F for proper starch indicator reactions.

The sample must be condensed under pressure with the *throttle valve on the discharge side of the cooling coil.* The throttling valve on the condenser should be located at a level lower than the outlet of the bottles in order to prevent any in-leakage of air. Tubing connections between the cooling coil and the sampling manifold must be free of sulphur or other reducing materials which react with iodine.

The bottles being filled with a sample for test should be placed in an empty vessel or bucket whose top or overflow is an inch or two above the height of the sample bottles. The smaller bottles should be placed on a block or support in the bottom of the bucket so that the outlet heights of all three bottles are at the same level. The sample bottles should be filled from the bottom by inserting the tubes to the bottom of the bottle.

Sampling procedure is as follows:

(1) After the cooling coil, rubber tubing and manifold are in place, flush the system, including the bottles and bucket, with a good flow of cooled sampling liquid for at least thirty minutes before sampling.
(2) After thirty minutes empty the bottles and the bucket to collect test samples.
(3) Adjust the sample flow to a rate between one and two liters per minute for at least ten minutes. Both the bottles and bucket will have filled and be overflowing by this time.
(4) Slowly withdraw the manifold tubes and carefully insert the ground glass stoppers into the bottles below the surface of the water level in the bucket.
(5) Remove each bottle from the bucket and invert to see if any air bubbles are present. If air bubbles are present discard all samples and repeat.

Fixing:

The addition of each reagent to the sample shall be made through a 2 ml. pipette or dropper *while the sample bottles are submerged below the water level in the bucket.* A separate pipette must be used for each solution and be thoroughly rinsed after each determination. The stopper of each bottle must be removed while it is submerged and after the addition of each reagent, the bottle should be taken out of the bucket and inspected for the presence of air bubbles. If bubbles are found, all of the samples should be discarded and fresh ones collected.

Fix the 500 ml. sample and one 250 ml. sample successively as follows:

(1) Remove the stopper and add to the submerged sample 2 ml. manganous sulfate.
(2) Replace stopper, remove bottle from bucket and examine for air bubbles.
(3) Re-submerge sample bottle, remove stopper and add 2 ml. of alkaline potassium iodide, again examine for bubbles and allow for a five minute reaction time.
(4) Remove stopper while submerged and add 2 ml. of sulfuric acid.
(5) Replace stopper and thoroughly mix. The sample is now fixed.

Titration:

The first sample consists of the contents from the 500 ml. bottle and the second sample consists of the contents from the 250 ml. sample bottle *and* the 250 ml. sample which was unfixed.

Procedure for titration is as follows:

(1) Empty the 500 ml. sample into the titration dish and pipette into it 2 ml. of potassium bi-iodate. (.00313 N)
(2) Add 2 ml. of starch indicator and titrate to the end point (disappearance of blue color) using standard .00313N sodium thiosulfate. Empty and rinse the dish. The number of ml. of thiosulfate required is designated as "A".
(3) Empty the contents of both the "fixed" 250 ml. sample *and* the "unfixed" 250 ml. sample into the titrating dish and repeat the (1) and (2) procedures. The number of ml. of thiosulfate required is designated as "B".

Calculations:

A minus B times 0.1 equals parts per million of oxygen as O_2. PPM times 0.7 equals c.c. per liter.

pH — HYDROGEN ION CONCENTRATION

A rapid field method for determining the pH of steam, condensate, feedwater, boiler water, raw water or condensate is as follows:

Measure 10 ml of sample in a 10 ml graduate that has been rinsed several times with the sample to be tested. Add 3 to 5 drops of A-C Universal Indicator and mix. Avoid contamination during mixing. Compare the color developed with the table below.

COLOR	ph	COLOR	pH
Red	3.0	Green	8.0
Deeper red	4.0	Bluish green	8.5
Orange red	5.0	Greenish blue	9.0
Orange	5.5	Blue	9.5
Orange yellow	6.0	Violet	10.0
Yellow	6.5	Reddish violet	10.5
Greenish yellow	7.0-7.5	Deeper reddish violet	11.0

PRICE LIST - *Testing Equipment . . . Services*

TESTING APPARATUS

10 ml graduated cylinder	$1.10
25 ml graduated cylinder	1.10
50 ml graduated cylinder	1.10
58.3 ml graduated cylinder	1.50
100 ml graduated cylinder	1.65
No. 3 casserole (140 ml)	1.65
No. 4 casserole (340 ml)	1.95
Automatic burette 10 ml	5.50
Automatic burette 10 ml, stem only	4.00
Pipette 2 ml	.35
Pipette 25 ml	1.10
Dropper bulb and 0.5 ml pipette	.20
Rubber bulb for burette	.65
250 ml oxygen bottle	1.10
Erlenmeyer flask, 250 ml	.55
Burette, glass stop cock, 10 ml	4.00
Burette, glass stop-cock, 25 ml	4.00
Glass bead-rubber valve for burette	.10
Rubber stopper	.15
Dropping bottle for indicator	.30
Soap bottle	.30
Funnel, 65 mm	.55
Stirring rod	.15
Gum rubber tubing, per ft	.15
1 oz. dropping bottle with 0.5 ml pipette	.40
Dipper for sulphate indicator	.20
Filter paper 9.0 cm, per box #1	.55
Filter paper 9.0 cm, per box #5	.65
Filter paper 12.5 cm, per box #31	1.95
Filter paper 12.5 cm, per box #42	2.75
Powdered charcoal (filter aid 1 lb)	.90

COMPLETE TEST KITS

Allis-Chalmers Test Kit — Steel cabinet and all necessary equipment to make the following tests: Hardness, Alkalinities, Chlorides and pH determination	49.50
"S & B" Method Test Kit — Carrying Case and necessary equipment to make hardness titrating determination	27.25

DISSOLVED OXYGEN KITS:

(a) Steel cabinet and all necessary glassware and reagents for determining dissolved oxygen by the bi-iodate modification of the Winkler method	27.50
(b) Steel cabinet and all necessary glassware and reagents for determining dissolved oxygen by the Schwartz-Guerney method	33.00
(c) Allis-Chalmers cooling coil, control valve and tip for sample collection	27.50
(d) Bailey (high pressure) cooling coil	82.50
Taylor low (or high) Phosphate Comparator	31.00
Taylor Water Analyzer for silica determinations	20.00
500 ml ammonium molybdate solution — for silica determination	2.00
Taylor pH Slide Comparator, Model T	24.00
5 ml test tubes	.25
0.5 ml pipettes	.20
20 ml vials (empty)	.20
Mixing tubes, high phosphate, (5, 15, 17.5 ml)	.60
Mixing tubes, low phosphate (10, 14 ml)	.60
Water analyzer tubes (Pyrex)	1.00
Single color Standards ampoules	.60
Distilled water ampoules	.15
Color standard slides	10.00
Dalite lamp	10.00
Taylor Nitrate Comparator — For determining nitrate in boiler water . . . including base, color slide and reagents	21.50
Apparatus and reagents for excess sulfite test	16.50
ALLIS-CHALMERS CONDUCTIVITY METER, INCLUDING CELL & BAILEY COIL . . . for panel or wall mounting or portable type	300.00
Conductivity cell	27.50
Bailey coil	82.50

LABORATORY ANALYTICAL SERVICE

Scale Analysis —	
X-ray diffraction method	16.50
Gravimetric procedure	33.00
X-ray and gravimetric analyses	41.50
Water Analysis —	
Complete gravimetric analysis	19.50
Boiler water analysis	5.50
Oil determination	3.50
Condensate analysis	5.50
Feed water analysis	8.50

REAGENT CHEMICALS

	1 oz.	4 oz.	8 oz.	Pint	Quart	½ Gal.	Gal.
Hardness Indicator Solution	.55	.85	1.10				
Hardness Buffer Solution	.55	.85	1.10	2.20	4.10		
N/50 Std. Acetate				1.00	1.65	2.75	4.95
Conc. Hydrochloric Acid			.50	.75	1.25		
Sulfuric Acid N/50				1.10	1.65	3.00	5.50
Soap Solution N/50				1.65	2.75	4.95	8.80
Sodium Carbonate N/44				1.10	1.65	3.00	5.50
Silver Nitrate N/58.5				1.40	2.20	4.15	7.15
Sodium Hydroxide N/7.1				1.10	1.95	3.60	6.60
Benzidine Solution				1.10	1.95	3.60	6.60

PRICE LIST - *Chemicals, Chemical Equipment*

REAGENT CHEMICALS

	4 oz.	8 oz.	Pint	Quart	½ Gallon	Gallon
10% Barium Chloride			.65	1.10	1.95	3.30
Methyl Orange Indicator	.65	1.10	1.95	3.60	6.60	
Methyl Purple Indicator (Fleisher)	.85	1.50	2.75			
Phenolphthalein Indicator	.65	1.10	1.95			
Potassium Chromate Indicator	.65	1.10	1.95			
Starch Indicator	.65	1.10	1.95			
Universal Indicator	3.00	4.95	8.80			
Manganous Sulfate Solution	.55	1.10	1.65			
1:1 Sulfuric Acid (50%)	.55	.85	1.10			
Alkaline Potassium Iodide	1.40	1.95	2.75			
Potassium Permanganate .00313N	.55	1.10	1.40			
Sodium Thiosulfate .00313N	.55	1.10	1.40	3.60	6.60	12.65
Potassium-Bi-iodate (.00313N for oxygen test)	.55	1.10	1.40			
Standard Iodide-iodate (for sulphite test)	.55	1.10	1.65	3.75	4.95	8.80
Molybdate Reagent — for phosphate determination			1.00	2.00		5.50
Conc. Stannous Chloride (Vial — $0.50)	1.00	2.00	3.00	5.00		
N/10 Nitric Acid	.30	.55	1.00	1.65		5.50
.03N Barium Nitrate			1.60	2.50		7.15
Propyl Alcohol (for Sulfate Test)				.85		2.20

	25 grams	50 grams	100 grams	200 grams	500 grams	1000 grams
A-C Sulfate Indicator	$3.30	$5.50	$8.25	$13.75	$28.00	$49.50

(All prices are F.O.B. shipping point and are subject to change without notice.)

WATER CONDITIONING CHEMICALS, EQUIPMENT AND CONSULTING SERVICE

AKON TREATMENT — An effective oxygen absorbent and sludge coagulant for boilers, either internally or externally treated. ****

AKON BRICKS — A solid composed of Akon treatment and softening chemicals for internal treatment in low to medium pressure ranges. ****

No. 26 INTERNAL TREATMENT — Used as oxygen scavenger and sludge dispersive agent for boilers, either internally or externally treated. ****

No. 30 SERIES — Powdered formulations combining all of the necessary softening chemicals with an organic dispersive material. ****

SILIMITE TREATMENT—Effective high magnesium dolomitic lime for silica reduction in connection with a hot process lime-soda softener. ****

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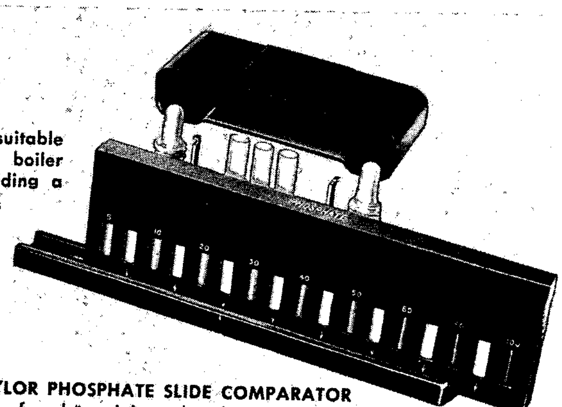
*****prices furnished upon request*

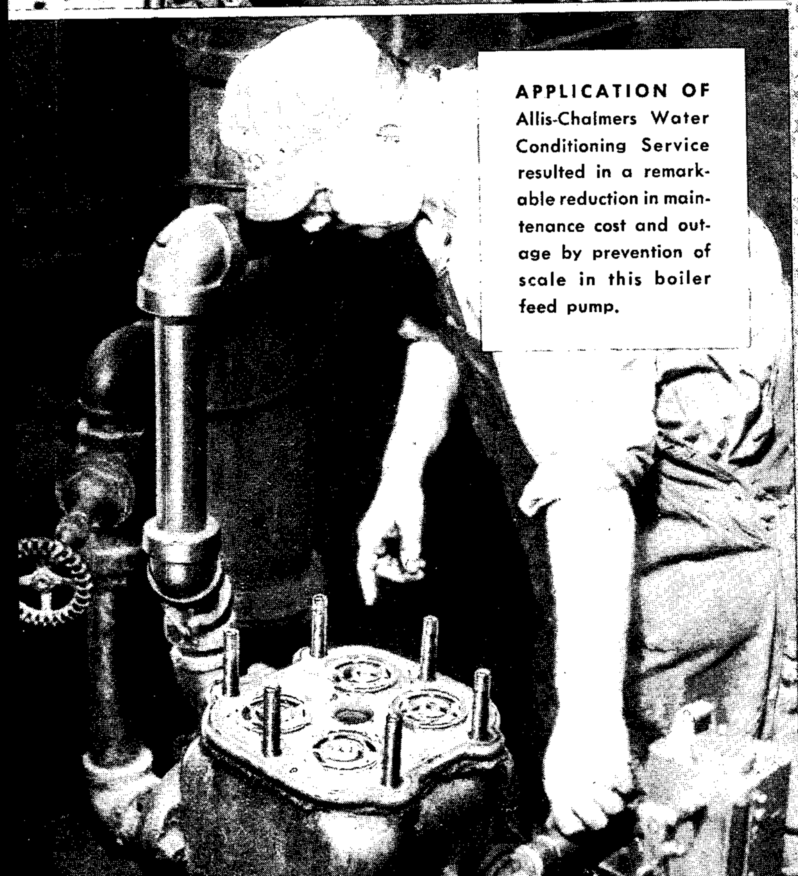
CONDUCTIVITY METER . . . suitable for detecting carry-over of boiler water with steam and providing a chart record of steam quality.



TAYLOR PHOSPHATE SLIDE COMPARATOR . . . for determining phosphate in boiler water. Color standard slides available for

EFFECTIVE ON-THE-JOB PROTECTION

A-C WATER CONDITIONING SERVICE helps eliminate costly down-time such as above . . . this large steam turbine had to be opened because of inadequate feedwater treatment.



APPLICATION OF Allis-Chalmers Water Conditioning Service resulted in a remarkable reduction in maintenance cost and outage by prevention of scale in this boiler feed pump.

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General Description of

Hot Process Water Softener

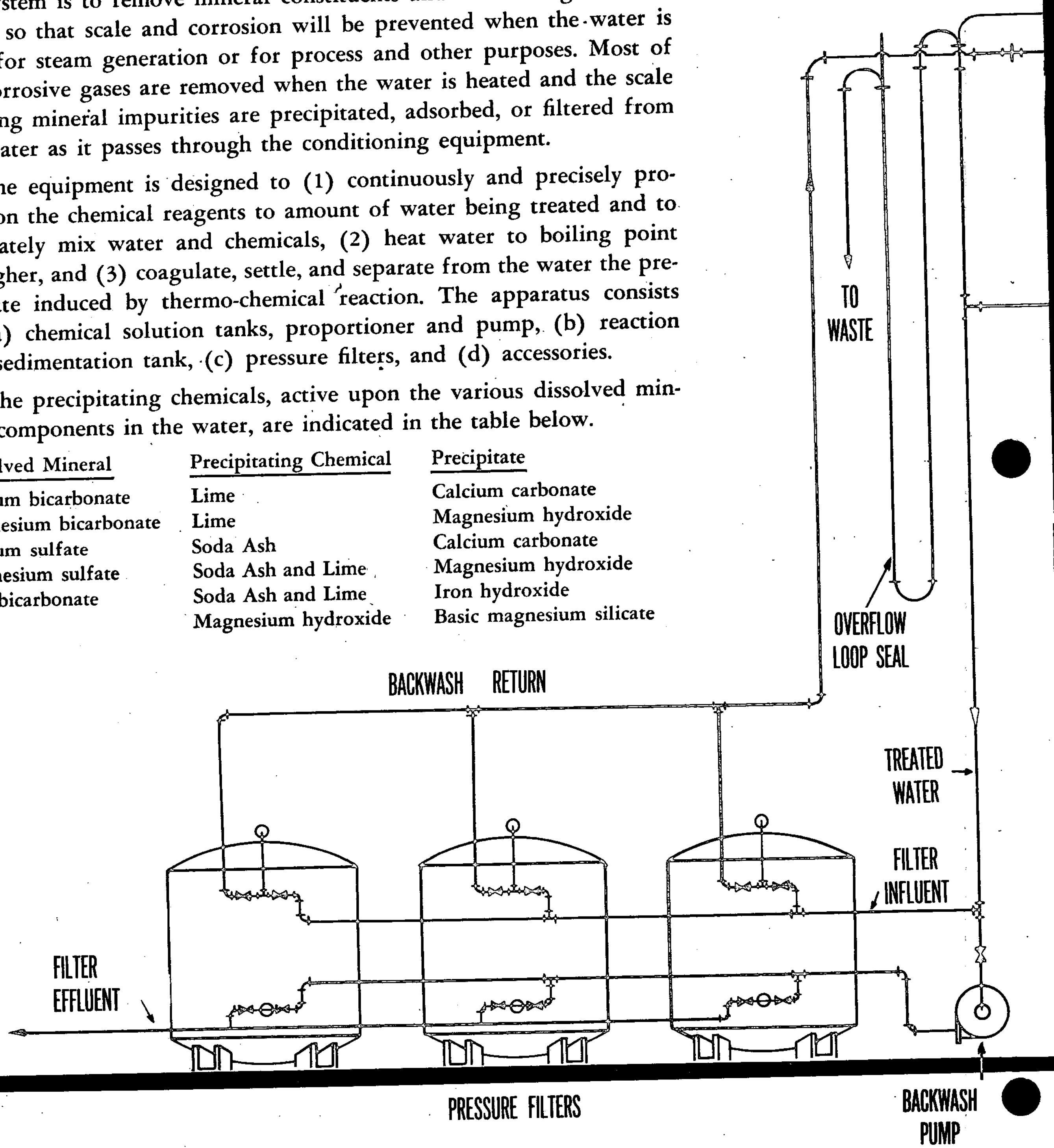
Function of Hot Process Water Conditioning

THE ESSENTIAL FUNCTION of a hot process water conditioning system is to remove mineral constituents and dissolved gases from water so that scale and corrosion will be prevented when the water is used for steam generation or for process and other purposes. Most of the corrosive gases are removed when the water is heated and the scale forming mineral impurities are precipitated, adsorbed, or filtered from the water as it passes through the conditioning equipment.

The equipment is designed to (1) continuously and precisely proportion the chemical reagents to amount of water being treated and to intimately mix water and chemicals, (2) heat water to boiling point or higher, and (3) coagulate, settle, and separate from the water the precipitate induced by thermo-chemical reaction. The apparatus consists of (a) chemical solution tanks, proportioner and pump, (b) reaction and sedimentation tank, (c) pressure filters, and (d) accessories.

The precipitating chemicals, active upon the various dissolved mineral components in the water, are indicated in the table below.

Dissolved Mineral	Precipitating Chemical	Precipitate
Calcium bicarbonate	Lime	Calcium carbonate
Magnesium bicarbonate	Lime	Magnesium hydroxide
Calcium sulfate	Soda Ash	Calcium carbonate
Magnesium sulfate	Soda Ash and Lime	Magnesium hydroxide
Iron bicarbonate	Soda Ash and Lime	Iron hydroxide
Silica	Magnesium hydroxide	Basic magnesium silicate



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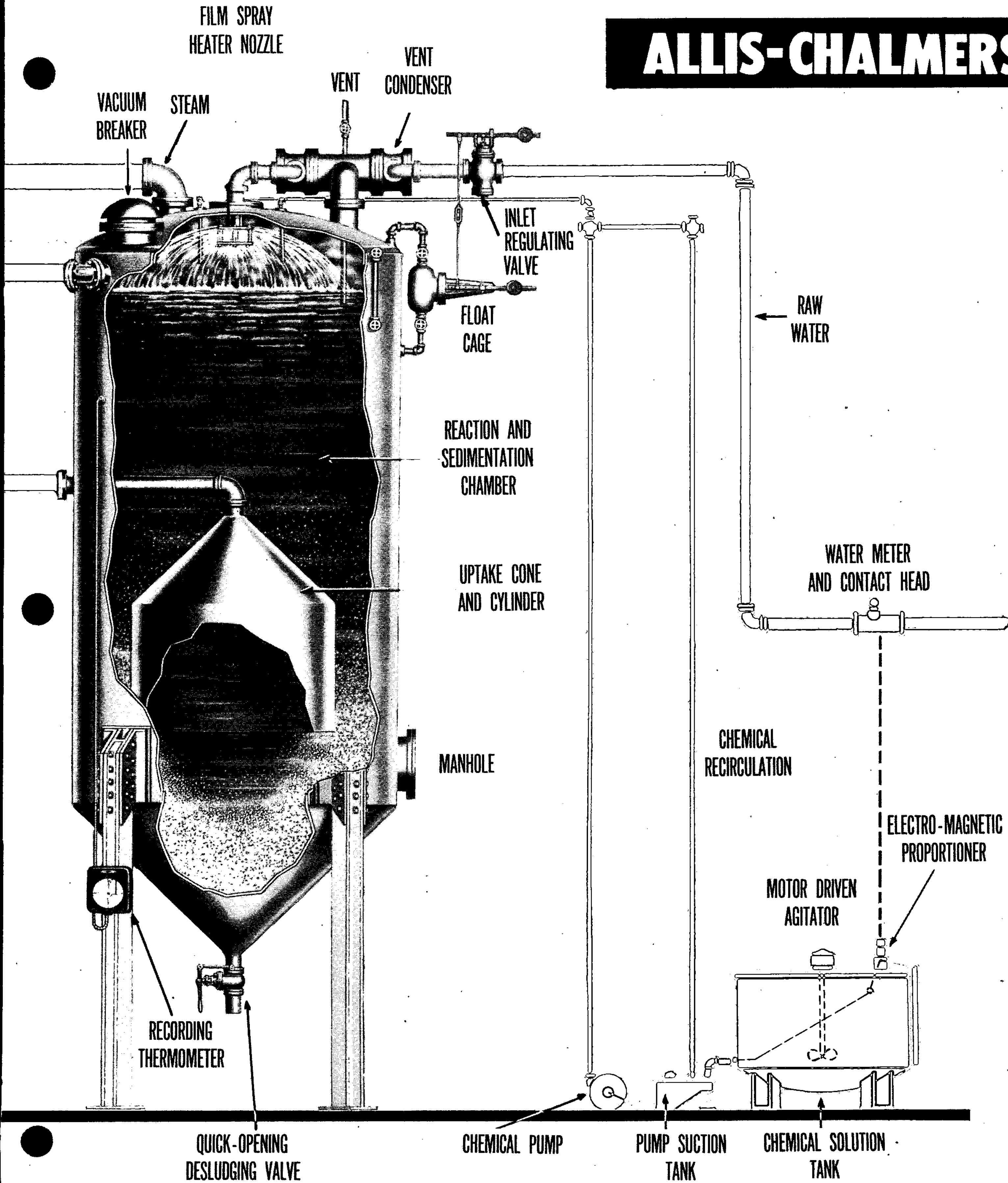

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Mechanism of Operation

THE UNTREATED WATER enters the water conditioning cycle at the meter. The water leaving the meter flows through a float-controlled inlet regulating valve and traverses a vent condenser where all but a small portion of the vent steam is condensed and much of the heat of the non-condensable gases is recovered before these gases are released to atmosphere. The preheated water leaving the vent condenser is then injected into the steam space of the softener tank through a spray nozzle which breaks up the water into droplets. This process makes it possible to quickly heat the water and free it of dissolved gases.

When a predetermined quantity of water passes through the meter, an electrical contact energizes the electro-magnetic proportioner mounted on the chemical solution tank. With each impulse, the proportioner lowers a swing take-off pipe into the chemical solution. This permits a flow of the chemicals to the chemical pump suction tank. From this tank it is pumped into the top of the softener, where it is mixed with the incoming water by dispersion or by means of a slow speed agitator, depending upon the size of the softener.

As the mixture of the water and chemicals travels slowly downward in the reaction and sedimentation tank, precipitation proceeds. The sediment resulting from this precipitation settles into the sludge cone. From here it is removed periodically through the desludging valve. The few finely divided precipitated particles which flow upward through the uptake cylinder and cone are removed when the water passes through the pressure filters. The clarified filter effluent is then transferred by a booster pump to a feedwater heater or storage tank or, in some cases, it may flow by gravity to boiler feedwater pumps. Water is drawn from the uptake cylinder for backwashing the filters and returned to the top of the softener.

When a deaerating type of softener is furnished, the deaerating heater section is installed above the reaction and sedimentation tank or within it. In such cases the treated water flows to the filters and the filtered treated water is pumped to the deaerating chamber where it is atomized for efficient oxygen removal.

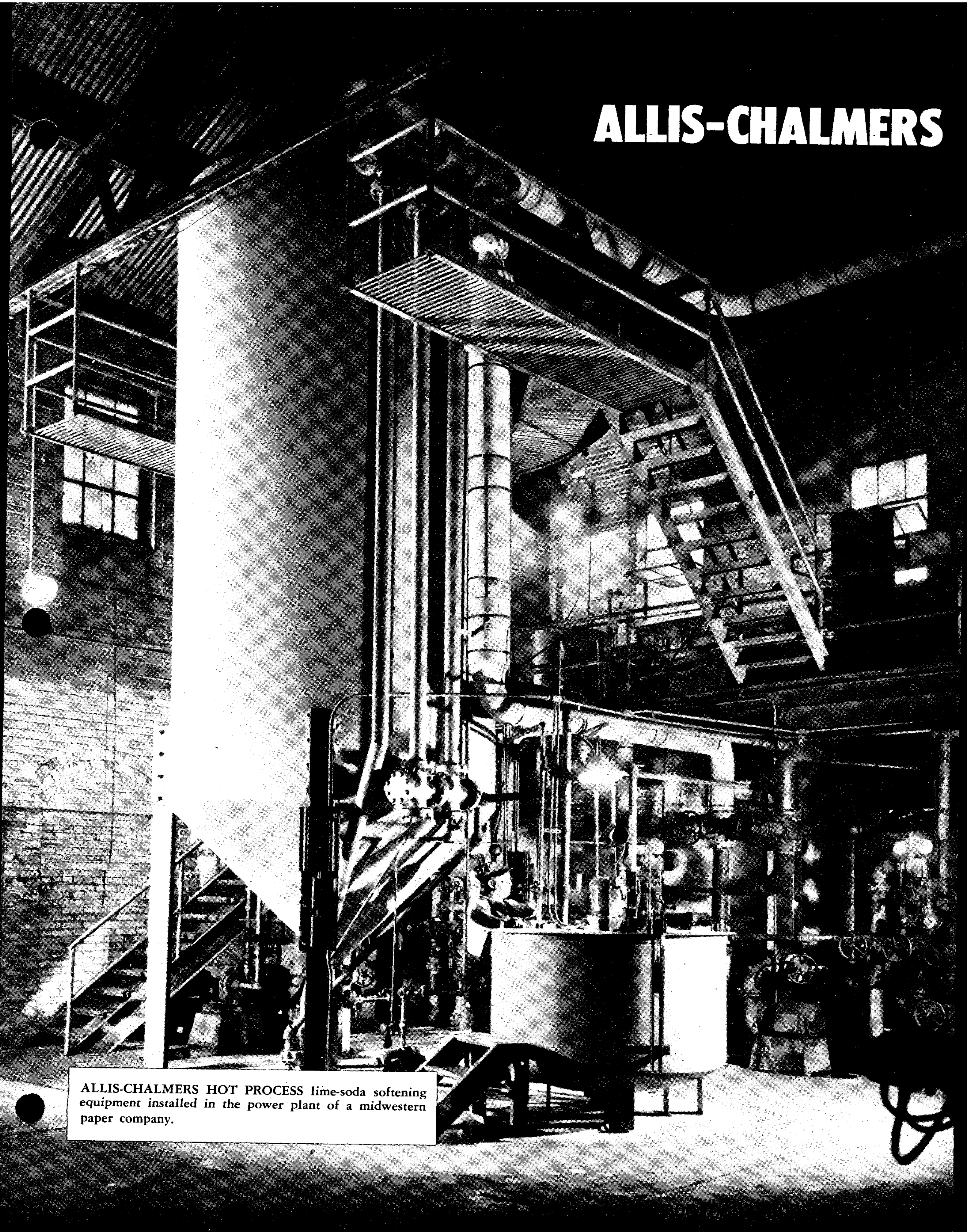
Reaction and Sedimentation Tank

● IN THIS VESSEL water is heated, treated, and separated from the major portion of mineral crystals resulting from thermo-chemical reaction. When the incoming water is mixed with the entering chemicals, precipitation of nucleii begins to occur. Further precipitation takes place on these nucleii increasing their size and weight. The greater size to which crystal nucleii grow, the faster is their rate of settling.

For the most effective settling, it is important that retention time in the softener be adequate for coagulation, agglomeration, and crystal growth. Allis-Chalmers hot process softeners are normally designed to retain unfiltered treated water one hour. If the type of raw water to be conditioned requires longer retention time, reaction tanks are designed accordingly.

If short-circuiting streams are induced within a softener by convection currents, or by internal compartments which divert the water flow, actual retention time may be less than calculated. Allis-Chalmers softeners are therefore designed and constructed to provide proper flow velocities and unobstructed straight-line water passage. The centrally located take-off system minimizes thermal convection currents.

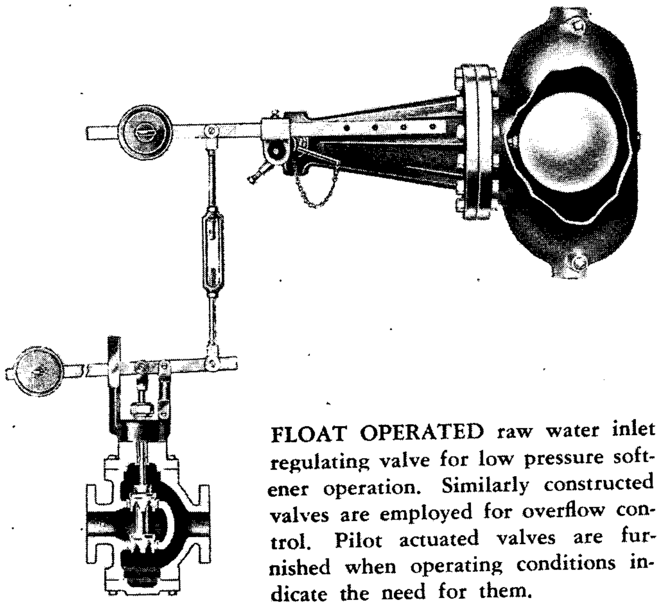
The reaction and sedimentation tank is of all-welded, high grade steel construction with dished head and conical bottom. Inspection manholes and terminal connections for inlet and outlet piping are provided. Tanks are ordinarily equipped with supporting clips for mounting on purchaser's steel leg supports or concrete piers. Steel leg supports are furnished on request, however.



ALLIS-CHALMERS HOT PROCESS lime-soda softening equipment installed in the power plant of a midwestern paper company.

Raw Water Inlet Regulating Valve

THE RAW WATER is admitted to the softener through a float-controlled inlet regulating valve which automatically maintains the water at a given level. The kind of float valve furnished—either lever operated or pilot actuated, as well as the type of inner valve construction — is selected individually for each installation to make certain of the proper operating control. The valve assembly consists of valve, outside float cage and float, equalizing piping to connect float cage to the softener, and shut-off valves.



FLOAT OPERATED raw water inlet regulating valve for low pressure softener operation. Similarly constructed valves are employed for overflow control. Pilot actuated valves are furnished when operating conditions indicate the need for them.

Spray Heater

THE SPRAY HEATER supplied with an Allis-Chalmers softener entirely fulfills the requisites of an ideal primary softener heater. To insure an intimate mixture of the incoming water with the steam present in the upper portion of the softener, the water is divided into a myriad of tiny droplets. A maximum of water surface is thus exposed to the enveloping steam blanket which quickly and efficiently elevates the temperature of the water to within two or three degrees of the saturated steam. The division of the water into infinitesimal particles also helps to evolve the major portion of free carbon dioxide and oxygen which is dissolved in the water.

The spray vanes of heater nozzle are constructed of special corrosion resistant flexible metal. They are normally closed at no flow and open under pressure in proportion to the flow of water. Effective spraying action is thus obtained at all flow rates up to the maximum for which the unit is designed. The incoming water keeps the spray head at a much lower temperature than that of the surrounding environment. Hence, with most water, there is little if any tendency for the nozzle to become fouled by the scale. It can, however, be readily removed for either inspection or cleaning.

A single spray nozzle is normally supplied. However, softeners of very large capacity are usually equipped with identical multiple nozzles.

Vent Condenser

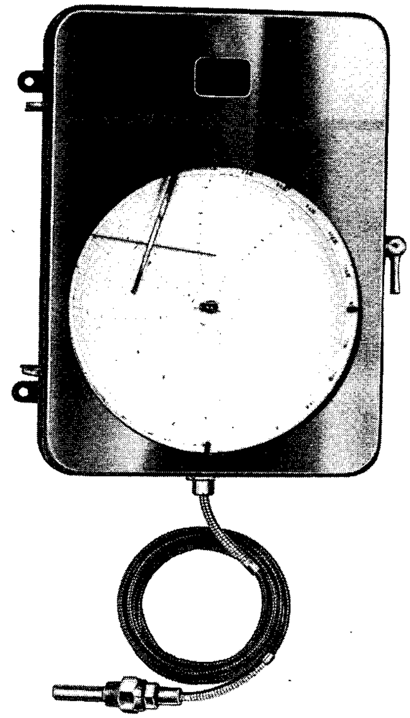
GASES EVOLVED FROM THE WATER by heating and by the reaction of the chemicals are released into the top of the softener. Since the steam space in the vent condenser is the coldest portion in the entire vapor space of the softener, there is a continuous induced flow of gas-entrained steam to that unit. There the companion steam is condensed and the cooled non-condensable vapors are expelled through a vent into the atmosphere. The condensate drains back freely into the softener because of the special construction of the vent condenser collecting system, vapor inlet openings and sealing device.

The vent condenser supplied by Allis-Chalmers is designed to operate automatically and without interruption over a wide load range. The shell is constructed of cast iron to minimize corrosion. Admiralty metal tubes are rolled into Muntz metal tube plates. Tubes are arranged for single pass or multiple pass as indicated by the service requirements and can be very easily cleaned or replaced. The water boxes are arranged for positive circulation of the cooling water. From a heat recovery point of view, vent condensers are seldom justified for small softeners. This becomes especially true when there is considerable excess of steam available which would be normally wasted.

ALLIS-CHALMERS

Vacuum Breaker

● VACUUM BREAKERS ARE PROVIDED to protect the softener tank from collapse due to any vacuum which might be induced by a sudden curtailment of the steam supply to the vessel, or by a sudden and large increase in the flow of cold raw water into the softener. The vacuum breakers are spring loaded and of heavy cast iron construction, with dome-type covers, stainless steel stems, and bronze sleeve guides. The number of vacuum breakers supplied is based on the softener dimensions and the capacity.



RECORDING THERMOMETER housed in dust and moisture proof case for surface or flush panel mounting, and furnished with separable socket and adequate length of flexible tubing.

Oil Separator

● IF ALL OR PART OF THE STEAM for heating the water in the softener is exhaust from steam engines or from other types of apparatus where cylinder oil is in direct contact with the steam, it is desirable to employ a separator to separate the oil from the steam. This unit is usually connected to the steam line immediately adjacent to the softener. Whenever a separator is required, the type provided is of durable construction and of such size and design as to effectively remove the oil without an excessive drop in steam pressure.

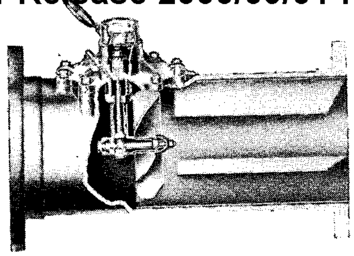
Overflow

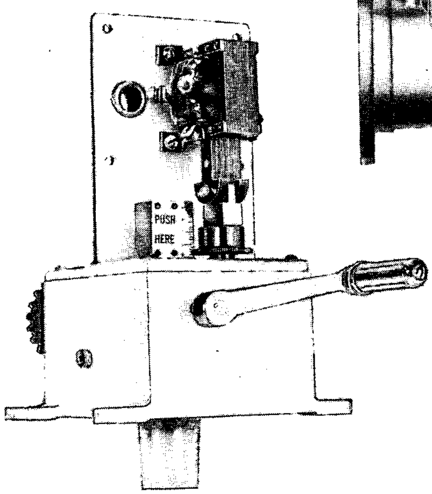
● A RISE OF WATER in the softener above the normal operating level is prevented by using an overflow loop seal or an overflow valve. Softeners which are designed to operate up to 5 psi are fitted with a connection to which the purchaser's loop seal piping is attached. The loop seal connection is made on the softener effluent line so that the seal is filled with treated water. This protects the piping from deposits which might occur if sealed with untreated or partially treated water.

An overflow valve is furnished when the steam pressure exceeds 5 psi or when space limitations or the length of loop seal piping required makes the use of a loop seal impractical. (Three feet of loop seal piping is recommended for each pound of steam pressure.) Overflow valves under four inches are generally lever operated, while those four inches or larger are pilot actuated.

Recording Thermometer

● THE MAINTENANCE OF PROPER TEMPERATURE is an important factor in the effective and efficient operation of a softener. A recording thermometer, therefore, is provided for temperature control. A suitable length of protected, flexible tubing is provided, together with a union connected bulb and separable socket. The synchronous motor and recording mechanism are housed in a dust and moisture proof rectangular case. This case is suitable for surface or flush panel mounting, whichever is preferred by the purchaser. The standard finish is black, rubberoid enamel.





PROPELLER - TYPE meter normally furnished for turbid water. Orifice and disc type meters are also employed depending upon service conditions.

ELECTRO - MAGNETIC chemical proportioner with dust-proof cover removed showing simple, rugged construction. Internal gears immersed in oil.

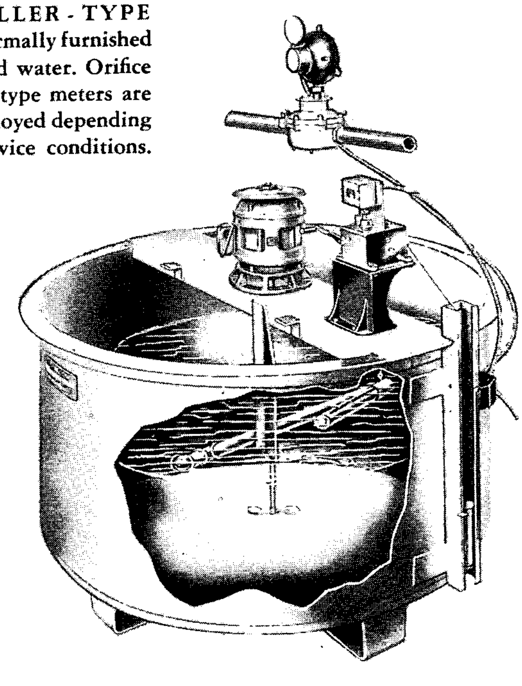
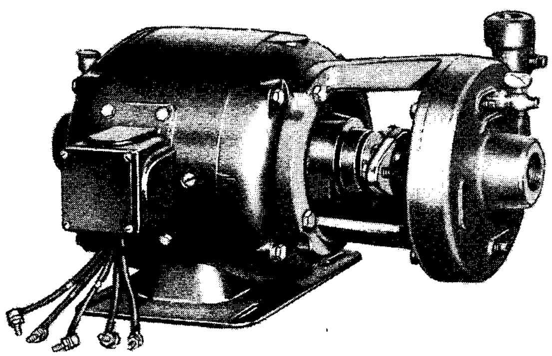


ILLUSTRATION OF chemical mixing and feeding tank (with cover removed) showing proportioning assembly and agitator.



PUMP AND MOTOR on one shaft. Motor totally enclosed for dust and moisture protection. Pump easily dissembled for cleaning or inspection.

Chemical Feeding Equipment

IF ANY ONE PIECE OF APPARATUS in a hot process softening system can be considered more important than another, it is the chemical proportioning equipment . . . this is the most vital part of the system. Even with a properly designed reaction and sedimentation tank and an efficient filtration system, there remains the problem of accurately proportioning the chemicals to the amount of water entering the softener through all ranges of flow rate. If an insufficient quantity of chemicals is fed, the water will be undertreated and the softening incomplete. If there is an overdosage of chemicals, excessively high alkalinities in the boiler water may result. This will produce conditions conducive to carryover.

Furthermore, water — particularly surface water — varies in composition from season to season and frequently from day to day and hour to hour. It is evident that the dosage of chemicals must not only be adjusted to the volume of water treated, but to the water composition as well.

The electro-magnetic proportioner supplied as a part of the Allis-Chalmers softener equipment is simple in design, sturdy in construction and precise in operation. The proportioner is mounted on the chemical solution tank. Electrical impulses received from the contact head attached to the water meter actuate the proportioner in direct proportion to the water flowing to the softener. An exclusive feature of the meter contact head is that it makes positive contacts during normal water flow so frequently that the chemical feed is practically continual. A mercury contactor is employed to eliminate arcing; there are no contact points to become fouled and inoperative. With each meter contact the proportioner lowers a swing take-off pipe a definite unvarying distance into the chemical solution, thus permitting a precise dosage of chemicals to flow into the pump suction tank. From here it is pumped to the top of the softener and mixed with incoming raw water. An automatically locked and quickly operated vernier adjustment on the proportioner permits micro-control of the quantity of chemicals fed.

The electro-magnetic proportioner is solenoid operated. The internal gears are immersed in oil. No chemicals or water are in contact with the proportioner; hence, there is no clogging or corrosion to affect the operation or dependability of the unit. The simple, rugged construction provides assurance of long life, precise performance, and freedom from maintenance expense. Its dependability is demonstrated by the five year performance guarantee which it carries. The meter supplied is of the orifice, propeller, or disc type, depending on service conditions. A compound type of meter is provided for large softeners when the range in flow rate is wide.

The chemical tanks are of sturdy steel plate construction variously designed with capacity to feed for either eight, 12 or 24 hour periods. A rigid, dust-tight cover, equipped with chemical charging door and inspection port, encloses the tank. The swing takeoff pipe head has a long slotted opening which receives the chemical solution as the head is lowered into the solution. The slot is of ample proportion to prevent clogging by suspended chemicals. A vertical motor, centrally located on the top of the chemical solution tank, drives directly a high speed propeller agitator. Shaft alignment and vibration are thereby eliminated. The propeller is designed and properly balanced to throughly mix the chemicals and to keep the lime suspended uniformly throughout the entire depth of solution. A perpendicular baffle, installed in the tank, guides the mixing motion vertically so that the solution surface is placid at the take-off head.

The take-off pipe counterweight is installed in a guide channel mounted externally on the side of the chemical tank. A pointer attached to the counterweight indicates the height of the solution in the tank. The solution level scale, mounted on the guide channel, is divided into ten equal divisions. Thus, the amount of chemicals to be added at any charging period is readily determined. A switch installed in the guide channel is tripped by the counterweight when the solution low level is reached, signaling by alarm to the operator that the tank needs recharging.

The pump suction tank receives the proportioned chemical solution flowing from the takeoff pipe. A reserve of solution in the tank and in the piping to the softener is maintained for recirculation by a float operated recirculating valve fastened to the pump suction tank. The chemical pump takes its supply from this tank. The pump is constructed with sufficient head and capacity to feed chemicals to the softener and to provide for recirculation of the chemical solution. The recirculation does not affect the dosage of chemicals entering the softener, since no dilution water is added. However, recirculation minimizes the settling of suspended chemicals by vastly increasing the solution flow rate in the piping system.

The chemical pump is an Allis-Chalmers Electrifugal unit with all-iron fittings, outside water seals, and a totally enclosed motor. The pump is normally furnished with a closed, non-clogging impeller, but an open impeller can be provided if preferred. Pump is easily disassembled and all parts are easily replaced.

One chemical feeder for lime and soda ash is normally provided; however, other chemicals may be fed and more than one feeder furnished. Multiple feeders are frequently used (1) whenever the composition of the raw water requires utmost flexibility in adjustment of the kinds of chemicals fed, (2) when the chemicals mixed prior to the softener are incompatible, (3) when the recharging time of a large feeder causes too long a delay in feeding chemicals, and (4) whenever it is more economical to install two small feeders rather than a very large one. Multiple feeders are operated by the same meter proportioner mechanism as a single feeder, thus, the same high accuracy in chemical feed is attained.

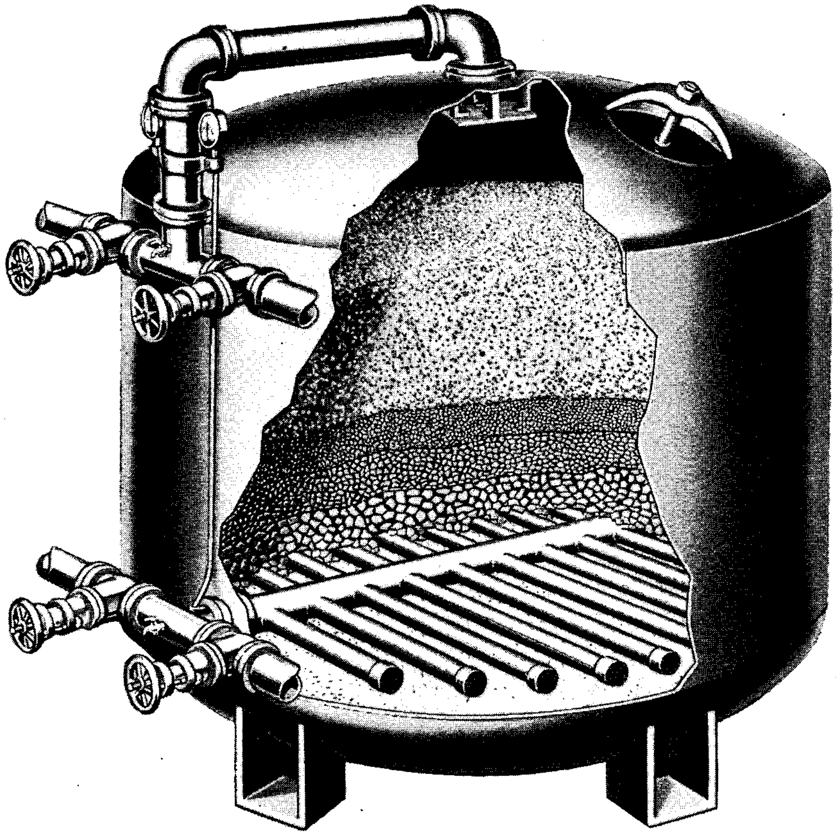
Filters

ALLIS-CHALMERS

● THE RESIDUAL PIN POINT PARTICLES, water borne from the softener, form a mat on top of the filter bed thus improving filtration. They are allowed to accumulate until (a) a predetermined time period has elapsed, (b) the maximum permissible loss of head is attained, or (c) the desired filtration rate is no longer obtainable. The filter is then taken out of service and deposit is removed by backwashing the bed in reverse direction with treated water drawn from the uptake cylinder in the softener. The uptake cylinder furnishes an ample supply of backwash water without adversely affecting normal circulation within the softener. The backwash pump provides sufficient water velocity and pressure to expand the filter bed, scour the filter medium, remove the deposit, and transport it to the top of the softener.

A deflector plate installed in the top of the filter distributes the incoming treated water and prevents its impingement upon the filter bed. The bed consists of specially selected Anthracite, properly sized and uniform in all gradings from coarse to fine. An underdrain system in the bottom of the filter consists of manifold and lateral piping. The laterals are perforated on close centers with the perforations placed downward — assurance that the water-flow through the filter during filtration, as well as backwashing, will be uniformly distributed across the entire filter bed and that the distribution outlets will not become clogged by the bed material.

Vertical filters are furnished except where the filtration flow rate is high enough to justify the horizontal type. Filter tanks are welded steel plates with dished top and



FILTER TANK SECTIONALIZED
to show graded filter bed and water collecting and distributing system.

bottom heads of ample thickness to withstand operating pressure. They are ordinarily designed for 50 psi and hydrostatically tested at 75 psi. "U" type bent plate legs with large bearing areas evenly support weight of the filter. Jack type legs can be furnished if preferred. A large manhole provides easy access for inspection and cleaning. Complete valve nests for filtration and backwash control, together with immediate external piping, are supplied. Pressure gauges to indicate the pressure drop through the filter are provided as well as a backwash sight glass to show the condition of the wash water. Other accessories include air relief valves and sampling cocks. Strainer nozzles, rate of flow indicators, rotary filter surface washers, and air or steam agitators are included upon request.

The backwash pump is an Allis-Chalmers Electrifugal unit with splash-proof motor. All iron fittings are provided to withstand the high alkalinity of the treated water.

Condensate and Treated Water Storage

COMBINATION WATER SOFTENERS and storage tanks are furnished in a number of arrangements, depending on the preferred application. When condensate and/or treated water storage is an integral part of the softening system, the compartment is placed at the top of the softener surrounding the raw water downtake tube. Condensate enters the storage space, without valve control, through a heater nozzle similar to that provided for heating the raw water. Usually the condensate is discharged to the filter effluent piping.

Uncontaminated condensate contains no hardness. Mixed with unfiltered treated water it will dissolve a portion of the suspended sludge and therefore absorb hardness. Consequently, when treated water is to be combined with condensate in the Allis-Chalmers softener, it is filtered prior to mixing and storage. There are additional advantages in this arrangement. Frequently, the ratio of condensate returns to make-up water is high, and if only the treated water is filtered, less filter area is required. Also, filtration of the treated water prior to storage provides a supply of completely conditioned feedwater which is instantly available for use. When the filtered treated water is stored with the condensate, it enters the condensate piping ahead of the film spray heater nozzle and is thus reheated. A booster pump is used to transfer the filtered treated water to storage and the flow is controlled by a float-operated inlet regulating valve. Filtered treated water enters the storage compartment only when there is insufficient condensate return to maintain the desired feedwater reserve level.

Phosphate Softening

THE RESIDUAL HARDNESS in treated water from a hot process lime-soda softener will usually range from 10 to 25 parts per million, depending upon the composition of the raw water and the quantity of chemicals fed. When it is desirable to reduce the hardness to approximately zero — as in high pressure boiler operation — a secondary phosphate softener is installed. It is generally constructed like the primary softener except that it may be designed for a shorter retention time. Filtration then follows the phosphate softening.

Separate phosphate feeders are furnished and are actuated by either the primary softener water meter or by an additional metering device, depending on the requirements of the individual application.

Where desired, internal phosphate treatment following a hot process lime-soda softener can be fed directly to the boilers. The feeding equipment consists of a proportioner, chemical solution tank and accessories, motor driven agitator, and pump suction tank with float switch. Single or multiple pumps as determined by the service conditions, are also supplied.

Silica Removal

● THE HOT PROCESS SOFTENING CYCLE has proved to be an effective method and economical means of removing soluble silica from boiler make-up water. The silica reduction is accomplished through adsorption by magnesium hydroxide. The hydroxide may be formed from the magnesium present in the raw water or magnesium added as a reagent. The degree of adsorption varies with the initial concentration of silica in the water, the desired silica reduction, the temperature, and the quantity, selective character, and colloidial condition of the magnesium hydroxide. Reduction of silica to two or three parts per million is generally obtainable.

Magnesium reagents commonly used for silica reduction are magnesium carbonate, magnesium sulfate, calcined magnesite, magnesium oxide, dolomitic lime and *Silimite. Silimite,* an Allis-Chalmers product, is an activated dolomitic lime. Where lime requirements for softening the water are low, it may entirely replace the lime. In other instances the lime equivalent in the amount of *Silimite* required for the desired silica reduction is deducted from the normal lime dosage. *Silimite* can be mixed with the lime and/or soda ash and thus, does not require a separate feeder.

The amount of magnesium reagent required can be reduced considerably by recirculating a portion of the sludge that is settled in the softener sludge cone. This is accomplished by means of a small circulating pump or an eductor. Recirculation of the sludge, dispersed into the incoming raw water, not only salvages and utilizes the partially spent adsorptive properties of the magnesium hydroxide but it also aids in accelerating the sedimentation of the precipitate resulting from the lime-soda reaction.

Boiler Water Recirculation

● BOILER BLOWDOWN WATER contains sodium hydroxide and sodium carbonate, both of which are softening agents. Consequently, there will be some saving in chemical costs when a portion of such water is introduced into a hot process softener. The composition of the raw water, the operating conditions of the individual plant, as well as other factors, determine the feasibility of that practice. Terminal connections on the softener for receiving and distributing boiler blowdown are provided, therefore, only when requested by the purchaser.

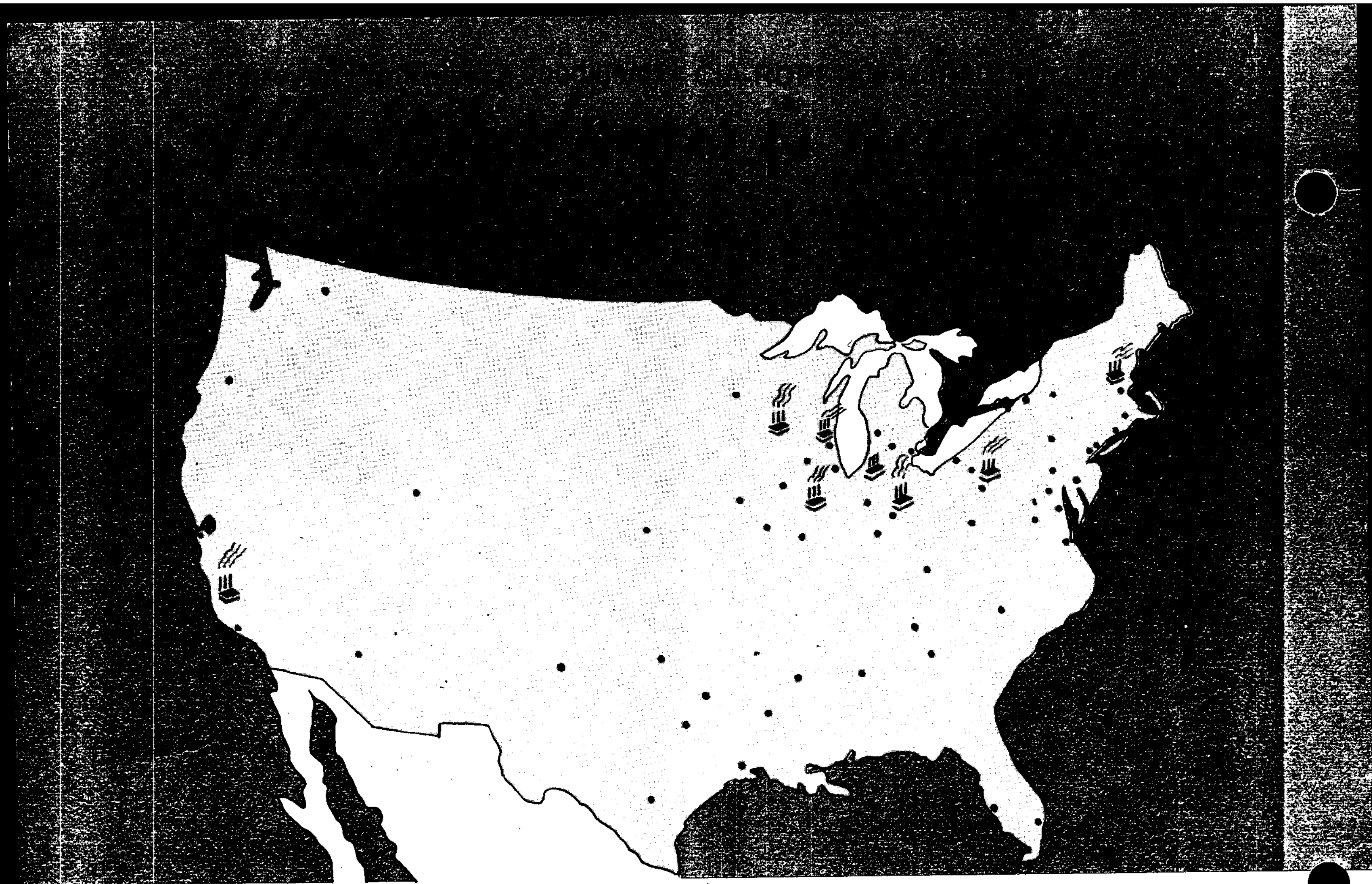
ALLIS-CHALMERS

Test Kits

● A SUITABLE TEST KIT, including metal cabinet, glassware, and the initial quantity of reagents, is provided for analyzing the softener treated water and making adjustments in the chemical treatment. A test kit for oxygen determination is supplied whenever deaerating equipment is furnished.

Additional Types of Allis-Chalmers Water Conditioning Equipment

Cold Process Lime Soda Softeners • Filters • Filter Material • Sodium and Hydrogen Zeolite Softeners • Zeolite Material • Degasifiers • Deionizers • Clarifiers • Oil Removal Filters for Condensate • Boiler Feedwater Treatment.



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Instructions
for

INSTALLING
OPERATING
REPAIRING

ALLIS-CHALMERS

MULTI-STAGE

Centrifugal Pumps

Approved For Release 2000/09/01 : CIA-RDP83-00423R001000330002-2

For your convenience, this instruction book has been prepared in two sections — Pages 2 through 21 containing information of a general nature . . . and Pages 22 through 48 containing information on specific types of high pressure pumps.

It is to your advantage to read all of the general information section before proceeding to the section devoted to your particular pump.

Table of Contents

Proper installation is essential to keep your pump operating satisfactorily and efficiently. Improper installation and operation may ruin a pump in a short time. You are urged to consult our engineers freely regarding problems of your particular installation.

Please inform us in advance as to the date of initial operation, for we may wish to have one of our engineers present. This may be desirable in that it is good insurance against premature operational difficulties.

REFERENCE LIST OF TYPES AND SIZES

See figure and page number for cross-sectional views. Parts are identified by part number and nomenclature on fold-out back cover. Where more than one figure is listed or alternate bearing arrangements are shown, inspection of your pump will indicate which construction is applicable.

1. General Information

A. INTRODUCTION

We are pleased to welcome you as a user of Allis-Chalmers centrifugal pumps. Your pump is the product of careful engineering and skilled workmanship — it has been carefully inspected and thoroughly tested and will give long, efficient trouble-free service, provided proper care is taken in its installation and operation. We suggest you read this book carefully and keep it on hand for future reference. If additional information is required, it may be obtained upon request to the factory.

B. TESTED AT FACTORY

Allis-Chalmers centrifugal pumps are shop-tested for hydraulic and mechanical performance with the most advanced scientific testing equipment. Every important factor entering into the performance of a pump is checked with scientific accuracy and the virtual elimination of human error. A copy of the original test performance curve is available from the factory upon request. (See page 12 for information on checking shop test against field test.)

C. WARRANTY

The Allis-Chalmers Mfg. Co. warrants that the pump shall be of the kind and quality described in the specifications, and no other warranty, except of title, shall be implied. The conditions of any test shall be mutually agreed upon and the Company shall be notified of, and may be represented at all tests that may be made. If any failure to comply with the specifications appears within one year from date of shipment, the Purchaser shall notify Allis-Chalmers Mfg. Co. immediately and the Company shall thereupon correct the defect or defects by repair or by replacement, F.O.B. factory, of the defective part or parts. If the apparatus is installed by, or its installation supervised by the Company, said one year shall run from completion of installation, provided same is not unreasonably delayed by the Purchaser.

The liability of the Company (except on warranty of title and on the liability respecting patents) arising out of the supplying of said apparatus, or its use, whether on warranties or otherwise, shall not in any case exceed the cost of correcting defects in the apparatus as above set forth, and upon the expiration of said one year all such liability shall terminate. The Company shall not be liable for indirect or consequential damages.

2. Receiving

A. UNLOADING

The unit should be unloaded by placing the hitch around the body of the pump and drive. *Do not lift by placing the hitches on the base or around the bearing brackets of the equipment.*

B. CHECK SHIPMENT

As soon as the pump arrives at destination, it should be carefully inspected to determine any shortage or damage, checking each item with the shipping manifest furnished. Should any shortage or damage be found, it should be immediately called to the attention of the local freight agent of the railroad over which the shipment arrives, and proper notation be made by him on the freight bill. This will prevent any controversy when claim is made to the railroad, and will facilitate prompt and satisfactory adjustment.

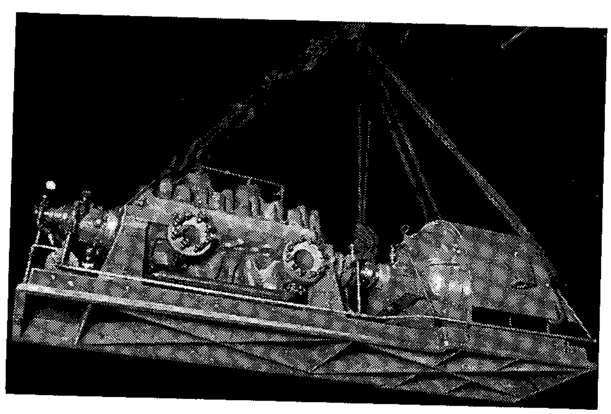

Fig. 1 — Method of attaching hitches.

3. Installing

A. LOCATION OF UNIT

In selecting a location for your pump the following factors must be considered:

The pump should be installed as near the supply of water as possible, with the shortest and most direct suction pipe practical. The total dynamic suction lift (static lift plus friction losses in suction line) should not exceed the limits for which the pump was sold. When possible, it is advisable to locate the unit below the pumping level of the water, to facilitate priming.

The pump should be placed with sufficient accessibility for inspection and maintenance. A clear space and ample head room should be allowed for the use of an overhead crane, hoist or A-frame sufficiently strong to lift the heaviest part of the unit.

Select a dry place if possible.

B. FOUNDATION

The pump and drive are normally mounted on a common baseplate before shipment. The couplings between the drive and pump are aligned accurately, and the pump is bolted firmly to the baseplate, however, the motor is only bolted temporarily. *The unit must be aligned properly after the base has been grouted in its permanent position.*

The baseplates normally furnished are of the fabricated steel type construction. The underside is ribbed for strength, but the base does not become a rigid member until after grouting.

The foundation should be sufficiently substantial to absorb any vibration and to form a permanent rigid support for the baseplate. This is important in maintaining the alignment of a direct connected unit. A concrete foundation on a solid base should be satisfactory.

Foundation bolts of a specified size should be accurately located, as shown on the general arrangement drawing provided. Each foundation bolt should be located in a bushing three diameters larger than the bolt to allow free movement of the bolt in conforming to the holes in the baseplate. See Figure 2.

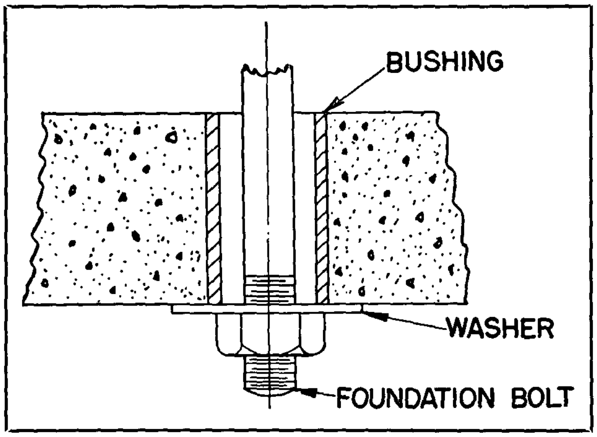

Fig. 2 — Bushing and bolt arrangement in the grouting.

C. BASEPLATE ALIGNMENT (Fig. 3)

The baseplate should be supported on the foundation on rectangular metal blocks and shims, or on metal or hardwood wedges having a small taper. Small jacks made of cap screws and nuts are convenient for large units. The support pieces should be placed close to the foundation bolts directly under the part of the baseplate carrying the greatest weight, and spaced close enough to give uniform support. A gap of 1 to 1½ inch should be allowed between the baseplate and foundation for grouting. Adjust the metal supports or wedges until the shafts of the pump and driver are level. Check the coupling faces and the suction and discharge flanges of the pump for horizontal or vertical position with a level.

Angular and parallel misalignment are corrected by adjusting the wedges or shims (A and C, Fig. 3) under the baseplate. After each change, it is necessary to recheck alignment of the coupling halves, since adjustment in one direction may disturb adjustments already made in another direction. It should not be necessary to place shims under the pump; all shims and adjustments should be made under the driver.

The pump and driver were assembled on the leveled baseplate and closely aligned before the unit was shipped. The pump is doweled to the baseplate, but the driver dowels are left out. After the unit has been completely aligned, including the alignment of the coupling, the driver dowels should be put in.

The coupling pins and bushings should not be inserted until the piping has been connected and the couplings aligned. *The motor rotation should be checked and corrected if necessary before coupling the pump and driver.*

D. GROUTING

A form should be placed around the baseplate 2 in. away from the drain lip, but providing an access to the drain connection. The form should extend from the rough foundation to the top level of the drain lip. The grout should then be poured into the base cavity through every large hole in the top of the baseplate provided for that purpose. Depending upon the slump, it may be necessary to allow the grout to set for a short time after it has flowed to the top level of the outer form. The base should then be filled and tamped until no hollow spots are detected by tapping on the base with a hammer.

Allow the grout to set completely before proceeding with alignment.

E. COUPLING ALIGNMENT (Fig. 3)

1. Flexible Coupling

The inaccurate alignment of the flexible coupling results in rapid wear of the rubber coupling bushings, heating of the bearings and possible loss of efficiency. *A flexible coupling will not compensate for misalignment.*

The coupling bolts are removed before shipment and should not be installed until the pump has been

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completely aligned, the suction and discharge piping attached, another alignment check made and the motor rotation checked against the direction arrow on the pump. Clean off all paint and burrs on the coupling before checking alignment.

Tighten foundation bolts firmly. After the baseplate and pump have been firmly bolted, align the drive to the pump by using the straight-edge taper gauge furnished with the pump unit (B—Fig. 3).

Whenever the pump or driver, or both, are heated during operation (when driver is a steam turbine or pumps are handling hot liquid), the unit should be properly aligned under the heated conditions. This is necessary to compensate for the changes in alignment resulting from the expansion from the cold to hot conditions.

For units with drives below 500 horsepower, unless otherwise shown on drawing, the faces of the coupling halves should be spaced far enough apart so they cannot strike each other when the driver rotor is moved hard over towards the pump. Due allowance should be made for wear of the thrust bearings. A minimum dimension for the separation of the coupling halves is specified on the General Arrangement Drawing furnished with each pump. Refer to this drawing before final setting of the coupling is made.

For units with drives over 500 horsepower the coupling halves are set for a limited end-float of the motor. They are set to allow the drive and pump shafts to touch. The coupling cover will limit the float in the outboard direction. The thrust bearing of the pump is large enough to carry any magnetic thrust developed by the motor. The normal operation, however, with the motor on its magnetic center, will allow for a nominal gap between coupling halves. The actual setting should be obtained from the General Arrangement Drawing furnished.

Angular alignment is checked by inserting a taper gauge (B—Fig. 3) between the coupling faces at four points spaced at 90 degree intervals and comparing the distance between the faces at these points. The unit will be in angular alignment when the measurements show that the coupling faces are the same distance apart at all points.

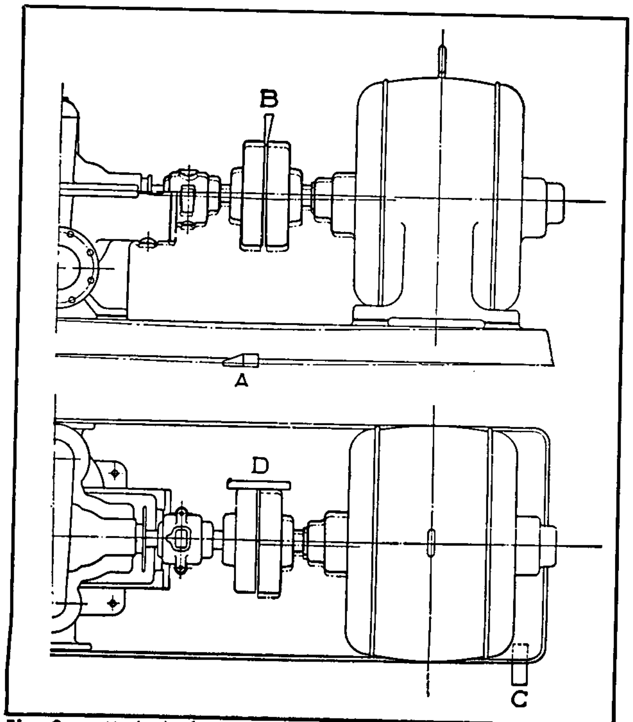

Fig. 3 — Method of aligning baseplate and flexible coupling.

A check for parallel alignment is made by placing a straight edge (D—Fig. 3) across the coupling rims at the top, bottom and both sides. The unit will be in parallel alignment when the straight edge rests evenly on the coupling rims at all positions.

Proper allowances must be made if the couplings are not concentric or of the same diameter. Place the chiseled match marks on the coupling edges together and make alignment checks. Revolve both half couplings 90 degrees or ¼ turn and again make the alignment check. The couplings should be revolved together through one complete turn of 360 degrees and the alignment check made each 90 degrees. The average and difference of these readings will indicate the necessary movement. The drive can then be adjusted to obtain the same gap and straight-edge readings taken at every point.

A more precise method of aligning the coupling halves is by the use of a dial indicator. Bolt the indicator to the pump coupling half with the indicator button resting on the rim of the driver coupling half. Set the dial at zero and chalk mark the coupling half where the button rests. For any check, top, bottom or sides rotate both shafts the same amount, i.e., all readings on the dial must be made with the button on the chalk mark. The dial reading will indicate whether the driver has to be raised or lowered, or moved to either side. After each movement, check that the coupling faces remain parallel to one another.

Example: If the dial reading at the starting point is set at zero and the diametrically opposite reading at the bottom or sides shows a plus or minus .020 inch, the driver must be raised or lowered by shimming, or moved to one side or the other by half (½) of the reading — .010 inch.

2. Gear Type and Falk Grid Type Couplings

Gear type and grid type couplings are aligned in the same manner as outlined above. However, the coupling covers must be moved out of the way, and measurements made on the coupling hubs, or on any surface turned and faced true with the bore of the coupling.

3. Spacer Type Coupling

The following procedure should be followed for aligning a spacer type coupling: Remove the jackshaft between the pump and the driver. Make a rigid bracket which can be fastened to either of the coupling halves and be long enough to reach the other coupling half. Fasten the bracket to either coupling with the dial indicator fastened to the bracket arm and in contact with the rim of the other coupling half. The procedure for the indicator is the same as previously described.

After alignment of the coupling rim has been made, change the indicator so it bears against the face of the same coupling half and make the necessary adjustments. If the shafts have end play, it is preferable to make the gap measurements with an inside micrometer.

After the one coupling half has been aligned fasten the bracket to the aligned coupling half and use the indicator against the rim and the face of the opposite coupling half.

4. Pin and Rubber Bushing (Fig. 4)

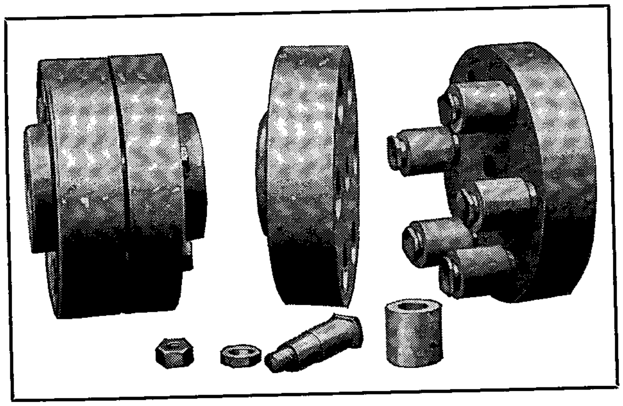

Fig. 4 — Pin and rubber bushing coupling. Assembled coupling is shown on left, exploded view on the right.

These couplings consist principally of two cast iron discs, one of which is mounted on the driving and the other on the driven shaft.

Projecting from the face of one of the discs are a number of rubber bushings, which consist of rubber covered brass tubes assembled on studs rigidly bolted to the drive disc. Each of these rubber bushings fits an accurately machined hole in the opposite disc. The clearance between rubber bushings and holes is slight and is only sufficient to allow the two halves of the coupling to be assembled and separated. The power is transmitted through these rubber bushings, which tend to reduce any jar or shock incidental to starting or to change in load.

This coupling is not intended as a universal joint to correct misalignment, and while it is capable of taking care of slight angular variation in the shafts, it should, nevertheless, be carefully aligned.

The two halves of the coupling are shrunk on the shafts, with the face of each half flush with the end of the shafts. The couplings can be removed by applying a small amount of heat and using a coupling puller.

The rubber bushings are inserted in the pump half of the coupling with a washer between the bushing and the face of the coupling. The coupling pin locks the washer between the shoulder of the pin and the face of the drive half of the coupling after tightening. Proper assembly permits the two coupling halves to be axially independent of each other.

5. *Magic-Grip* Couplings (Fig. 5)

The "Magic-Grip" coupling consists principally of two cast iron discs and two "Magic-Grip" bushings. The bushing is of the split type which allows it to slide easily on the shaft. The outer diameter of the bushing and the inside diameter of the coupling are tapered. There are four drilled recesses in the bushing which accommodate the "OFF" and "ON" position of the set screw holes of the coupling. The recesses in the bushings are off-set in such a manner that when the set screws are tightened the bushing will either draw in on the taper and tighten on the shaft or push out of the taper and loosen on the shaft.

Projecting from the face of one of the discs are a number of rubber bushings, which consist of rubber covered brass tubes assembled on studs and rigidly bolted to the drive disc. Each of these rubber bushings fits an accurately machined hole in the opposite disc. The clearance between rubber bushings and holes is slight and is only sufficient to allow the two halves of the coupling to be assembled and separated. The power is transmitted through these rubber bushings, which tend to reduce any jar or shock incidental to starting or to change in load.

This coupling is not intended as a universal joint to correct misalignment, and while it is capable of taking care of slight angular variation in the shafts, it should, nevertheless, be carefully aligned.

a. How to Install the *Magic-Grip* Coupling

Slide "Magic-Grip" bushing on pump or motor shaft with the recess holes away from the machine. Place the coupling over the bushing. Insert both set screws in the "ON" position and tighten alternately until coupling is tight on shaft.

b. How to Remove the *Magic-Grip* Coupling

Remove both set screws from "ON" position and insert in "OFF" position. Turn set screws until coupling is free on bushing. Loosen set screws and remove coupling from bushing. Remove bushing.

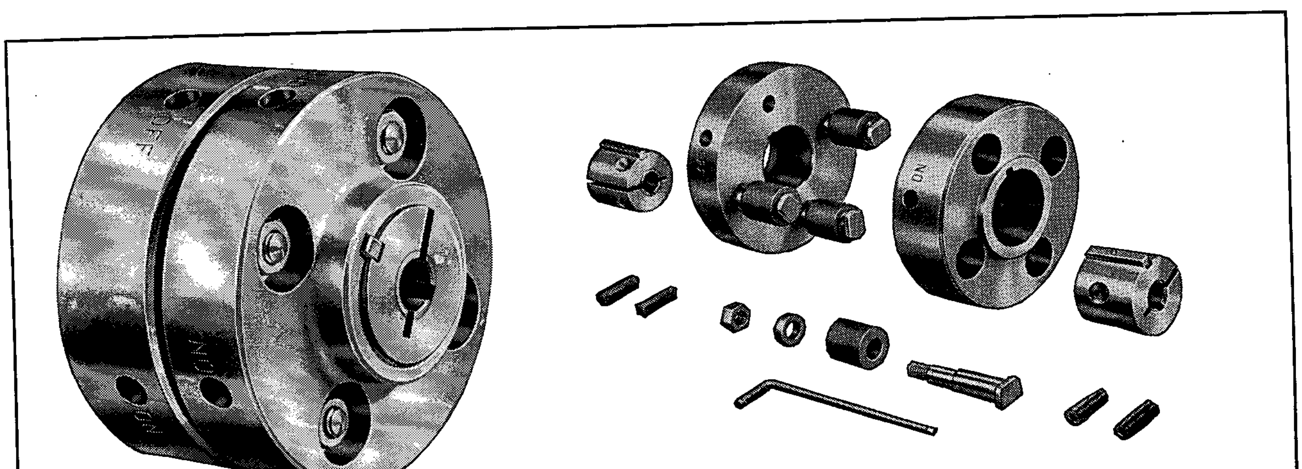

Fig. 5 — Assembled *Magic-Grip* coupling shown on left. Note the recesses in the bushing for the set screws in the exploded view on the right.

F. PIPING

Both the suction and the discharge pipes should be independently supported near the pump so when the flange bolts are tightened no strain will be transmitted to the pump casing.

It is usually advisable to increase the size of both suction and discharge pipes over the nozzle sizes to decrease the loss of head from friction. The piping should be arranged with as few bends as possible, and the bends should be made with a long radius wherever possible to decrease the loss of head from friction.

Where steel piping is used in the suction and discharge lines, it is recommended the pump companion flanges and gasket be bolted to the pump before a final weld is made to the steel pipe. This will insure bringing the pipe up to the proper position without putting a strain on the pump flange.

1. Discharge Piping

A check valve and a gate valve should be installed in the discharge line. The check valve, placed between the pump and the gate valve, is to protect the pump from excessive pressure and to prevent water from running back through the pump in case of a failure of the driving machine. The gate valve is used in priming and starting, and when the pump is to be shut down. To prevent water hammer it is advisable to close the gate valve before stopping the pump when a foot valve (see G below) is used. This is especially important when the pump is operated against a high static head.

On an automatic water system where a foot valve is used to keep the pump primed, the check valve should be omitted from the discharge line to prevent the pump from losing its prime if a slight leakage of the foot valve should occur.

2. Suction Piping (Fig. 6)

The suction piping should be kept free from air leaks. This is particularly important when the suction line is long or the static suction lift is high.

Trouble is often caused by the use of bell and spigot pipe in the suction line. Screwed or flanged pipe for the smaller sizes and flanged pipe for the larger sizes or for high suction lifts are recommended.

The suction pipe should slope upward to the pump nozzle. A horizontal suction line must have a gradual rise to the pump. If other piping is in the way, go under it. Any high point in the pipe will become filled with air and thus prevent proper operation of the pump. *A straight taper reducer should not be used in a horizontal suction line,* as it forms an air pocket in the top of the reducer and the pipe. Use an eccentric reducer instead. If an air pocket is left in the suction pipe when the pump is primed, it will often start and pump properly for a time, but it is probable that a quantity of air will be drawn from the air pocket into the pump, causing the pump to lose its prime. This is especially true when the pump is primed by the use of a foot valve. But even if the pump is primed by ejector or vacuum pump, the small quantity of air left in the pocket is increased by the air in the water released by the partial vacuum in the suction pipe, and from the air admitted through minute leaks in

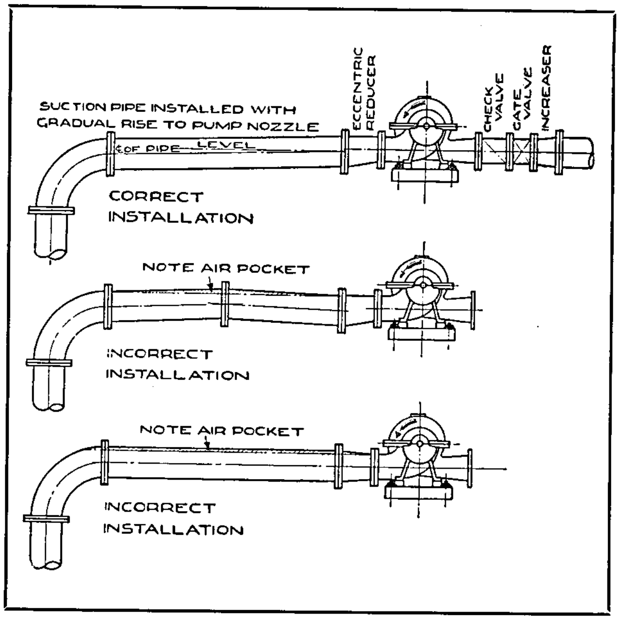

Fig. 6 — Correct and incorrect method of installing piping.

the pipe connections that ordinarily would not cause trouble. Small air pockets that may cause trouble are formed in the top of any gate valves installed vertically in the suction line. The gate valves in the suction line should be laid so the stems are horizontal. Trouble caused by an air pocket in the suction line can usually be stopped temporarily by priming and starting the pump several times. This will draw out enough of the air in the pocket so the pump will operate properly, but the trouble is liable to recur, so such a pocket should be eliminated.

Check valves should ordinarily have no place in the suction line, although they are sometimes used in series parallel operation to reduce the number of valves which are to be operated when changing from series to parallel operation. *The pump must not be throttled by the use of a valve on the suction side of the pump.*

Suction piping should not be installed with an elbow close to the suction nozzle of the pump, unless the elbow is in a vertical position. An elbow bending either straight up or straight down is permissible, but one entering at any other angle should not be used, for there is always uneven flow around an elbow. When an elbow is installed in any but a vertical position the unequal flow causes more water to enter one side of the impeller than can enter the other side, thus causing a thrust which will heat the thrust bearing and possibly be of sufficient magnitude to cause rapid wear of the thrust bearing.

G. PIPING FOR BOILER FEED SERVICE

1. Suction Vent Pipe (Fig. 7, 8, 9, line 1)

The casing is tapped at the top of the two suction inlets to the first stage. These points should be connected back to the heater or other suction supply tank, unless there is considerable friction loss between this point and pump. In this case our engineers should be consulted for recommendations.

This connection should not be less than twice the

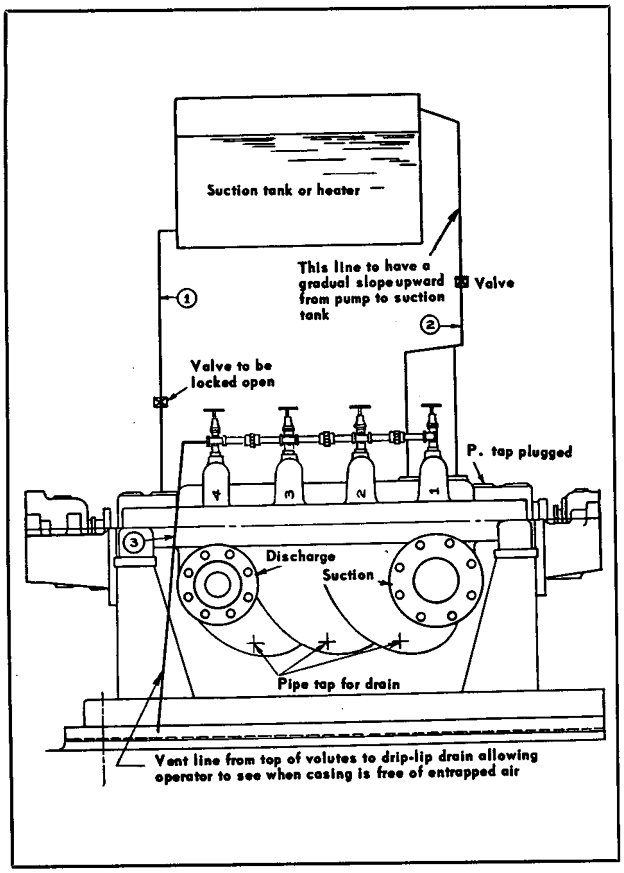

Fig. 7 — Recommended vent lines for multi-stage boiler feed pumps.

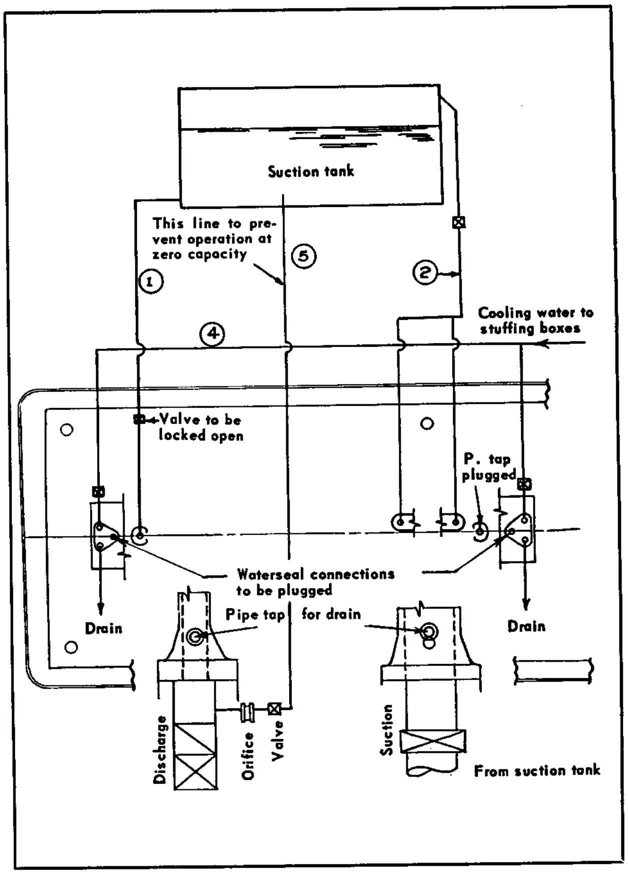

Fig. 8 — Recommended vent lines for multi-stage boiler feed pumps.

size of the vent connection and should slope continuously upward to the heater, with no low points to trap vapors. It should enter the heater at a point above the high water level.

2. By-Pass to Suction Supply (Fig. 8, line 5)

When the pump installation is such that there is a possibility that the pump will ever run with discharge valve closed, or without pumping any water, some arrangement must be made so as to circulate some water through the pump to keep it from overheating. This may be done by running a connection from the pump discharge or other suitable point back to the heater, thus allowing some water to be handled by the pump at all times. An orifice in this line is advisable to maintain proper amount of flow. The amount of water necessary to keep the pump cool varies so much with the size and type of pump that our engineers should be consulted as to the proper amount of water to be by-passed in any particular instance.

3. Cooling Water to Stuffing Boxes (Fig. 8, 9, line 4)

Where pumps are equipped with water-cooled stuffing boxes, a source of clean cool water should be connected to the point indicated on the General Drawing. Approximately two gpm per stuffing box is usually sufficient. The outlet from the cooling jacket should be connected so as to discharge into the drip lip of the base or other drain system. The

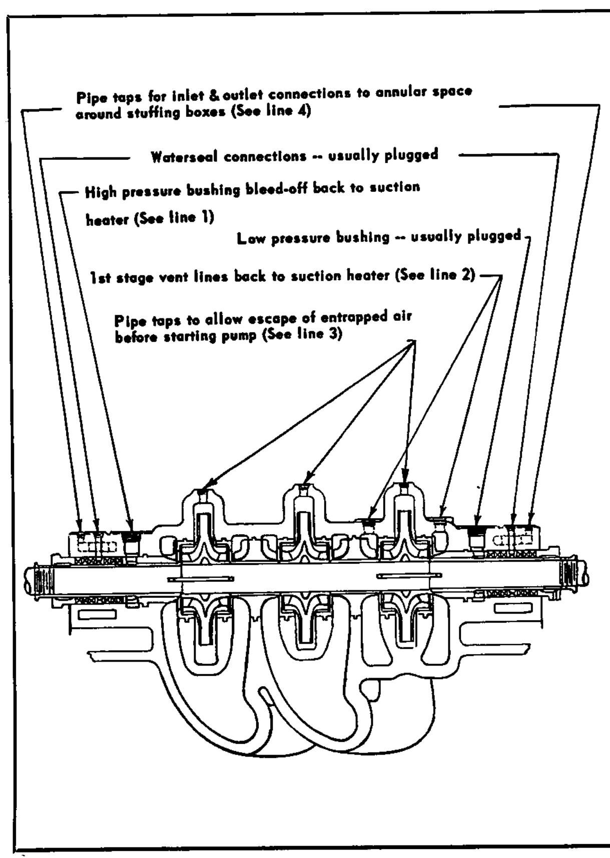

Fig. 9 — Assembly section of multi-stage pump showing various vent line connections.

discharge from this pipe should be arranged so that the amount of flow and temperature may be readily observed.

4. Stuffing Box Water Seal Connection (Fig. 8, 9)

Some boiler feed pumps are equipped with a seal cage in the stuffing box which serves as a packing spacer and the connection to this ring is usually plugged. In some installations it may be advisable to connect this point to a source of cooling water or possible to arrange to bleed off leakage to the deaerator or other point.

5. Stuffing Box Relief Piping (Fig. 7, 8, 9, line 1)

The leakage from the high pressure stuffing box bushing must be bled off preferably directly back to the suction heater at a point below the level of the low water in the heater. *FAILURE TO MAKE THIS CONNECTION WILL RESULT IN SEIZURE OR SERIOUS DAMAGE.* This arrangement protects against possible return of any leak into the suction of the pump which might flash or vaporize and cause trouble in the inlet of the first stage impeller. This is especially true where the suction pressure is not far above the vapor pressure. This piping should be kept separate from the suction vent piping. The General Arrangement Drawing will show location of this connection.

The barrel type pump has the relief piping included in the assembly by relieving the pressure back to the suction of the pump. This arrangement is possible because there is only one stage differential.

When the suction pressure is high all the pumps have a breakdown bushing on the suction end as well as the discharge end. In these cases the leakage from both bushings must be taken to the suction heater.

6. Oil Cooler

Where the unit is equipped with an oil cooler, the cooler inlet should be connected to a source of clean cool water with an outlet arranged so that the temperature and flow may be observed.

H. FOOT VALVE

When the suction lift is not very high it is frequently advisable to install a foot valve to facilitate priming. Foot valves should not be used when the pump is operating against a high static head, as failure of the power would allow the water to rush back suddenly causing a heavy water hammer. The foot valve should have a clear passage for water of at least the same area as that of the suction pipe. Care must be taken to prevent foreign substances from being drawn into the pump and choking the foot valve. An effective strainer should be provided for this purpose. When there is any refuse in the water, such as sticks, twigs, leaves, etc., a larger outside screen should be placed around the suction inlet to prevent choking the strainer. The flow through the screen should be below two feet per second.

I. PUMPS FOR CONDENSATE SERVICE

The casing of pumps for condensate service have a large suction chamber with a vent connection of liberal size. The vent should be piped with a continuous rise without pockets or traps to a point on the condenser well above the highest water line, and preferably to the point of lowest absolute pressure.

As the submergence of a condensate pump greatly affects the capacity of the pump at a given speed, the recommended minimum submergence is important for satisfactory operation.

The water used for sealing the stuffing box is usually piped to the glands from the pump discharge, where only a single pump is installed. Where two or more condensate pumps are connected to the same condenser, the sealing water connections are taken from the combined condensate pump discharge pipe to seal the glands of the idle pump as well as the running pump.

It is recommended that the water level in the hotwell be regulated by throttling the discharge of the condensate pump rather than by by-passing condensate back to the hotwell. This eliminates the tendency of the pump to operate at capacities beyond its recommended rating.

4. Operating

A. CHARACTER OF WATER

All guarantees of performance are based on pumping clear, fresh water, the temperature not exceeding 85 F unless expressly stated. If, after the pump is installed, there is reason to suspect that the water has a deteriorating effect on the metals of the pump, it is advisable to inspect the pump frequently so renewals can be made in sufficient time. Particular attention should be given to pumps handling sea water or acidulous water. Allis-Chalmers does not guarantee the metals to withstand any corrosive action of the water, however, it does advise the use of special metals where such corrosive action may occur.

B. FREEZING

Care should be taken to prevent the pump from freezing during cold weather when it is not in operation. Should the possibility of freezing exist during a shut-down period, it is advisable to drain the pump casing of its water by removing the drain plugs in the bottom of the casing and the suction passage, and blow out water in cooling jackets and dead-end passages.

C. PRIMING

Before starting the pump, the casing and the suction line must be filled with water. The pump must not be run unless it is completely filled with water, as there is danger of injuring some of the parts that depend upon water for their lubrication. Wearing rings, for instance, will not seize when the pump is filled with water, but they are very likely to do so if the pump is run dry. The pump may be primed by any of the following methods, the choice of which is dependent on conditions.

1. Priming by Ejector or Exhauster

When steam, high pressure water, or compressed air is available, the pump may be primed by attaching an ejector to the highest points in the pump casing as shown in Figure 10. This will remove the air from the pump and suction line, provided a tight valve is installed in the discharge line close to the pump. As soon as the ejector waste pipe throws water continuously, the pump may be started. After starting, a steady stream of water from the waste pipe indicates the pump is primed. If the steady stream of water is not obtained, the pump must be stopped at once and the process of priming repeated. A foot valve is unnecessary when this method of priming is used.

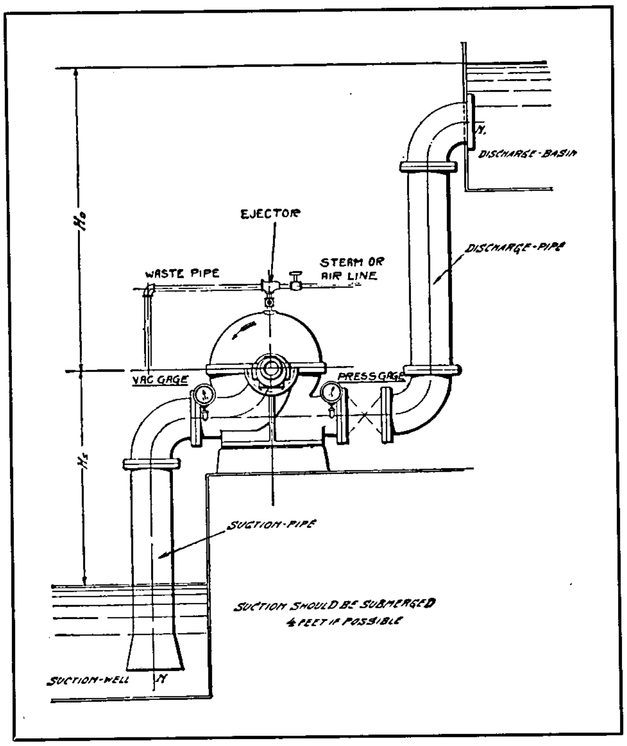

Fig. 10 Installation of ejector for priming pump.

2. Priming by Foot Valve Only

When it is not practicable to prime by ejector or exhauster, the pump may be primed by use of a foot valve. The foot valve will prevent water from running out through the suction inlet, and the pump can be completely filled with water from some outside source. The pet cocks on top of the pump should be opened during filling to allow the air to escape. A tight foot valve will keep the pump constantly primed, so it may be used for automatic pump operation. It must be inspected frequently, however, to see that it does not develop leaks and thus allow the pump to be started dry.

3. Priming by Vacuum Pumps

When neither of the above methods of priming are practicable, the pump may be primed with a vacuum pump to exhaust the air from the pump casing and the suction line.

a. Dry Vacuum Pump

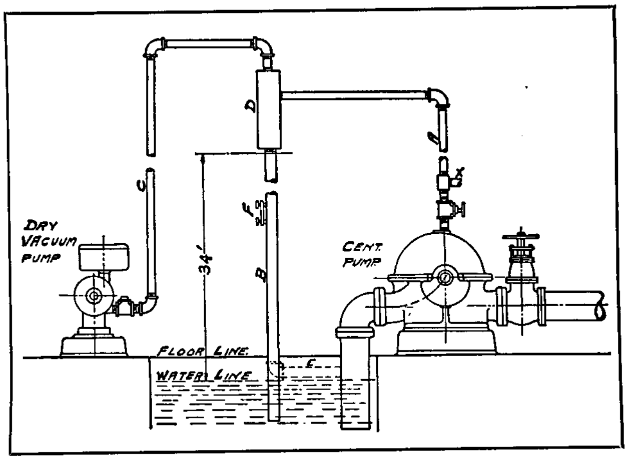

Fig. 11 — Piping arrangement for vacuum pump priming.

Pipes *A* and *C* should be about ¾ inch in diameter, and pipe *B* should be about 1½ in. in diameter. Pipe *D* should be a piece of six or eight-inch pipe about three feet long with threads on both ends. A standard six or eight-inch pipe cap should be placed over each end with holes tapped in for pipe *B* and pipe *C*. Pipe *A* should be tapped into the side of pipe *D* at about one-third of the distance from the top of the pipe.

To tell when the pump is primed, a water gauge glass *F* can be installed on pipe *B* slightly above the pump. When the water rises in the glass the pump is primed and the valve between the pump and the vacuum line can be closed.

The above priming arrangement is for one pump. To prime several pumps, the only addition is a pipe leading from pipe *A* to the other pumps. This pipe should be connected to enable any one pump to be primed, or all of the pumps to be primed at one time.

When pipe *B* cannot be run into the suction well, it can be connected to the suction pipe as shown by pipe *E*.

When using a dry vacuum pump water must be prevented from entering it. This is accomplished by having the pipe leading from the pump to the vacuum pump installed with a vertical rise of over 35 feet.

b. Wet Vacuum Pump

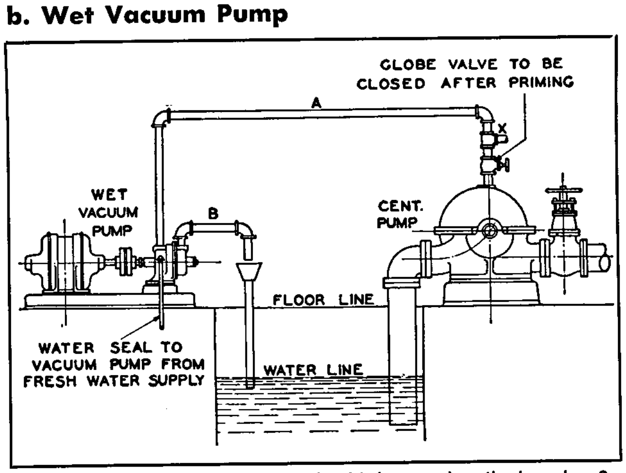

Fig. 12 The various pipe sizes should be as described under 3a for corresponding letters.

A wet vacuum pump is preferable, as it will not be injured if water should enter it.

4. *Careful attention to the method of priming when installing the pump may save annoyance later due to improper priming equipment.*

D. STARTING OF BOILER FEED PUMPS

1. Special Precautions

The modern high pressure centrifugal boiler feed pump is a sensitive piece of equipment, and proper installation and operation are essential to keep the pump operating satisfactorily and efficiently. A pump can be ruined in a short time by improper operation, or by lack of attention to some of the details in the installation.

1. High pressure boiler feed pumps are usually special in their application. The customer is urged to consult our engineers freely on problems pertaining to this installation, and advise us in advance as to the date of initial operation, for we may wish to have one of our engineers present. This may be desirable in that it is good insurance against premature operational difficulties.
2. Keep the pump full of water at all times.
3. Keep adequate head on suction at all times.

   Probably the greatest source of trouble in boiler feed pumps is the lack of sufficient suction head. Every boiler feed pump is based on a specific minimum total suction head above vapor pressure. Precautions must be taken to maintain this suction head at all times.

   The suction head must be adequate to protect the pump in case of sudden change in the feed water temperature. At 212 degrees F a rise of one percent in temperature, or two degrees, decreases the suction head about two feet, while at 300 degrees F a rise of one percent or three degrees, reduces the suction head about 17 feet. Hence, higher temperature pumps require a considerably wider margin of safety on the suction.
4. Arrange pump with a by-pass back to the bottom of the deaerator so that there will be a flow of water through it at all times when pumping against shut-off head. This will prevent heating and vaporizing of the water.
5. Proper attention to feed water will prevent scaling or corrosion. Sometimes scale is formed on pump parts causing them to seize due to reduced clearance, resulting in serious damage to the pump. Corrosive water on the other hand increases the clearances, resulting in a loss of efficiency and capacity and may cause serious damage to the casing and other parts of the pump.

   Allis-Chalmers maintains a Water Conditioning Department and the customer is urged to consult it on feed water problems.

2. Protective Devices

To guard against damage to the pump due to sudden changes in the operating conditions, certain protective devices are available. The added protection often justifies the expense of one or more of these protective devices:

1. Low suction pressure control which will shut down the unit if the suction pressure drops below a certain point.
2. Water temperature relay which will shut off the unit if the temperature of the water exceeds a certain point. This protects a pump from running with discharge valve closed.
3. Bearing temperature relays which shut the unit down when bearing temperature is abnormally high.
4. Low oil level alarm.

E. STARTING

When starting up a pump for the first time, the following points should be particularly watched.

1. The alignment should be checked at operating temperature, and the unit should turn over by hand perfectly free.
2. Loosen bolts, between pump and baseplate, on outboard end of pump to allow free expansion motion to pump. These bolts should be finger tight only.
3. Rotation of driver should be checked.
4. Fill bearings and oil pump as per instructions — pages 15, 16.
5. The suction valves must be wide open and a full supply of water to the suction assured.
6. Valves in the suction vent lines should be opened to the heater to remove any trapped vapor. These valves should remain open at all times. The high pressure bleed off line and by-pass should also be open and remain open during operation.
7. Discharge valve should be closed.
8. Gauges should be attached to the suction and discharge so that when the pump is started it can be seen at once that it is operating properly.
9. *PUMP SHOULD BE THOROUGHLY PRIMED BY VENTING AT THE TOPS OF ALL THE VOLUTES.* (Refer to Vent Line 3 — Fig. 7.)
10. When the pump is first started, it is best to turn it over without bringing it up to full speed; then shut off the switch to see that the pump turns over freely, and note whether the oil rings are turning, etc. If the pump is turbine driven, these features can be noted as the pump is started up gradually.

As the pump is coming up to speed, the discharge and suction gauges should be watched to see that the pump is building up pressure properly, and that the suction pressures have not dropped too low. After the pump is up to speed, the thrust bearing oil sight gauge should be inspected to see that it is pumping oil properly; the sleeve bearing oil rings should be checked and the glands should be watched to see that they are not running too hot, and that there is a slight flow of water out of the packing to keep it lubricated. If there is a force feed lubricating system, the flow of oil to the bearings should be adjusted to give a steady stream to each bearing. The cooling water to the oil cooler should be watched to see that its flow is proper and that the outlet temperature is not more than lukewarm, approximately 30 degrees C.

The stuffing box cooling water, if the pump has water cooled stuffing boxes, should be adjusted about the same way. About two gallons of water per minute for each stuffing box is usually sufficient.

The temperature of the bearings should be observed regularly for a few hours to see that the bearings are operating properly.

Where a force feed lubricating system is provided, the oil is pumped from a reservoir to the bearings. The discharge of the oil pump is through an oil cooler, thence into the bearings, actual lubrication being by the oil rings, and in the case of the thrust bearings, by the viscosity pumping action of the thrust collar. Some large size Kingsbury bearings and sleeve bearings are force fed directly to the bearings. The overflow from the bearings returns to the reservoir by gravity. A relief valve set at about 15 lb is provided on the discharge of the oil cooler, arranged to discharge back into the reservoir, if the pressure on the system exceeds 15 lb. This is to protect the oil pump should the valves in the oil system be shut off.

There is a check valve provided in the suction of the oil pump at the tank, and there is a loop in the pump suction, either of which will keep the pump primed. However, when first starting, or after long periods of shut down, the oil pump should be primed by pouring oil through the tee at the pump suction.

It should be noted again that the *BEARINGS MUST ALWAYS BE INDIVIDUALLY FILLED BEFORE STARTING THE UNIT FOR THE FIRST TIME, OR IF THE BEARINGS HAVE BEEN DRAINED.*

F. FIELD TESTS

This Allis-Chalmers pump has been accurately tested for hydraulic and mechanical performance at the factory before shipment. We recommend that a copy of the actual shop test be obtained from the factory before proceeding with a field test in order to check the field test against the factory test.

Complete procedure for testing pumps is given in the Standards of Hydraulic Institute Centrifugal Pump Section.

G. TESTING INFORMATION

Total head is the sum of total suction and discharge head. Where suction lift exists, total head is the sum of total discharge head and total suction lift. Where positive suction head exists the total head is the total discharge head minus the total suction head.

The datum for all gauge readings is taken as the center-line of the pump for horizontal shaft pumps and as the entrance eye of the suction impeller for vertical shaft pumps.

Suction lift exists where the total suction head is below atmospheric pressure. Total suction lift is the reading of a liquid manometer at the suction nozzle of the pump, converted to feet of liquid and referred to datum minus the velocity head at the point of gauge attachment.

Suction head exists when the total suction head is above atmospheric pressure. Total suction head is the reading of a gauge at the suction of the pump, converted to feet of liquid, and referred to datum, plus the velocity head at the point of gauge attachment.

Total discharge head is the reading of a pressure gauge at the discharge of the pump, converted to feet of liquid, and referred to datum, plus velocity head at the point of gauge attachment.

Velocity head is figured from the average velocity obtained by dividing the discharge in cubic feet per second by the actual area of the pipe across section in square feet and determined at the point of the gauge connection. It is expressed by the formula:

$$h_v = \frac{V^2}{2g}$$

where g = the acceleration due to gravity, and is 32.17 feet per second per second at sea level and 45 degrees latitude.

V = velocity in the pipe in feet per second.

The unit for measuring head should be feet. The relation between a pressure expressed in pounds per square inch (psi) and that expressed in feet of head is:

$$\text{Head in feet} = \text{psi} \times \frac{144}{w}$$

where w = specific weight in pounds per cubic feet.

All pressure readings of the liquid being pumped should be converted into feet.

Unless otherwise specifically agreed, the capacity, head, and efficiency guarantees are based on shop test when handling clear, cold, fresh water at a temperature of not over 85 F, and under suction conditions as specified in the contract.

The method of volume measurement should be made by some accurate and accepted method and converted to gallons per minute. The standard U. S. gallon contains 231 cubic inches. One cubic foot equals 7.4805 gallons. The specific weight of water at a temperature of 85 F shall be taken as 61.8 pounds per cubic foot. For other temperatures, proper specific weight correction should be made.

The formula for horsepower required by the pump is:

$$\text{Bhp} = \frac{\text{Total head x Gpm}}{3960 \text{ x Eff}} \text{V Specific Gravity}$$

$$\text{Eff} = \frac{\text{Total head x Gpm}}{3960 \text{ x Bhp}} \text{X Specific Gravity}$$

The shop test characteristic curve has been made up based on the rated speed. Therefore, for comparison, convert the field ratings after figuring the efficiency to the comparative shop speed. The conversions are made as follows:

$$H_{\text{field}} = \text{Head}_{\text{rated}} \times \left(\frac{\text{Rpm}_{\text{field}}}{\text{Rpm}_{\text{rated}}}\right)^2$$

$$\text{Gpm}_{\text{field}} = \text{Gpm}_{\text{rated}} \times \frac{\text{Rpm}_{\text{field}}}{\text{Rpm}_{\text{rated}}}$$

then calculate Bhp as based on above formula.

The power output of the motor or drive should be accurately measured by accepted and mutually agreed methods.

5. Stuffing Boxes

A. PACKING

The stuffing boxes are usually packed before shipment. If, however, the stuffing box is not packed, it should be carefully cleaned before packings are placed in it. Be sure that sufficient packing is placed back of the seal cage so the sealing water is brought in at the seal cage and not at the packing. The pipe supplying the sealing water should be fitted tightly so no air is brought in, as a small quantity of air entering the suction at this point may result in the pump losing its suction. *If the water to be pumped contains acid, dirt or grit, sealing water from some clean outside source should be piped to the stuffing box* to prevent damage to the packing and the shaft sleeves. In placing the packing, each packing ring should be cut to the proper length so the ends come together but do not overlap. The succeeding rings of packing should be placed in the stuffing box so the points of the several rings of packing are staggered. The packing should not be pressed too tight, as this may burn it and score the shaft. It should, however, be sufficiently tight to prevent water from coming around the outside of the packing, thereby depriving the packing of its lubrication. If the pump is packed with metallic packing and has been stored for a great length of time, it may be necessary to apply leverage to free the rotor. When first starting the pump it is well to have the packing slightly loose without causing an air leak. If the packing heats excessively, do not loosen the gland nuts, but rather stop the unit until the packing cools. Repeat this procedure until satisfactory operation is obtained.

When stuffing boxes are water sealed, be sure the water seal valves are open sufficiently to allow a

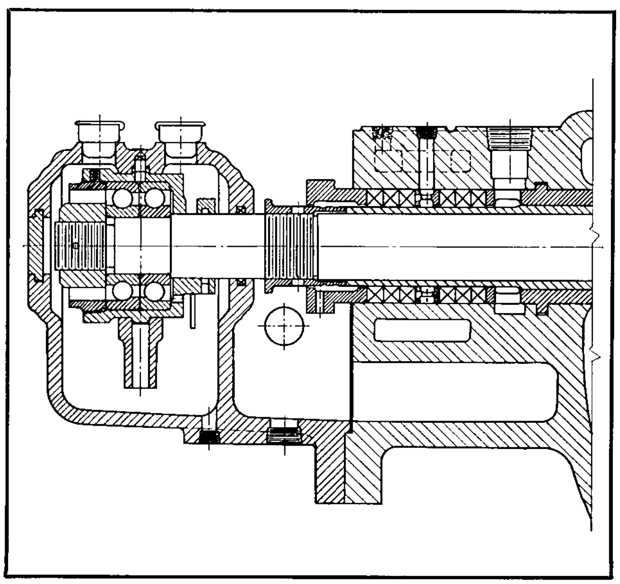

Fig. 13 — Arrangement of standard stuffing box.

slight leakage of water, but not open so much that the gland has to be drawn tight to prevent excessive leakage. The leakage should be piped away to a sump or sewer.

All pumps for general service are shipped packed with the highest grade of soft, square asbestos packing, impregnated with oil and graphite. Packing in which the individual strands are lubricated before braiding is successfully used on all usual pump applications, including pumps for boiler feed service handling water up to 212 F and for pumps circulating cold brine.

A soft, well-lubricated packing should always be used to reduce stuffing box resistance to the minimum and to prevent excessive wear on the shaft sleeves. Many brands of packing offered on the market have the desired characteristics. Those listed below should be regarded as typical rather than as specific recommendations:

No. 317	Anchor Packing Co.
Centripak Style C-7	Johns-Manville Co.
Garlock No. 234	Garlock Packing Co.
Monarch Style No. 454	Monarch Packing Co.
No. 193	U. S. Rubber Co.
Regal No. 49	Quaker Rubber Co.
Semi-Metallic	Bausman Packing Co.
Ace-O-Pak	Packing Engineering Co.

Metallic packing is furnished with many pumps designed for high temperature boiler feed service. Many brands of metallic packing offered on the market have the desired characteristics and are satisfactory — those listed should be regarded as typical rather than as specific recommendations:

Fel-Pro No. 309	Felt Products Mfg. Co.
Durametallic (alternate rings of grades B-110 and C-110)	Durametallic Corp.
John Crane No. 101 EO	Crane Packing Co.
Garlock No. 644	Garlock Packing Co.

Metallic packings are for use only with hardened steel shaft sleeves. Where bronze sleeves are furnished the packing should be of a soft grade.

B. MECHANICAL SEALS

A mechanical seal is used in place of a packed stuffing box when specifically requested. Two standard types are available — the Crane Mechanical Shaft Seal and the Dura Seal. Mechanical shaft seals are precision products and should be treated with care.

1. Crane Mechanical Shaft Seals (Fig. 14)

This seal requires no adjustments but it may be necessary to replace certain items should they become scored or broken. A seal which has been used should not be put back in service until the sealing faces have been replaced or relapped. Therefore, either complete seals or at least floating seats, seat rings, and seal washers must be kept on hand as spares. Once the seal faces have been disturbed the following procedure should be followed.

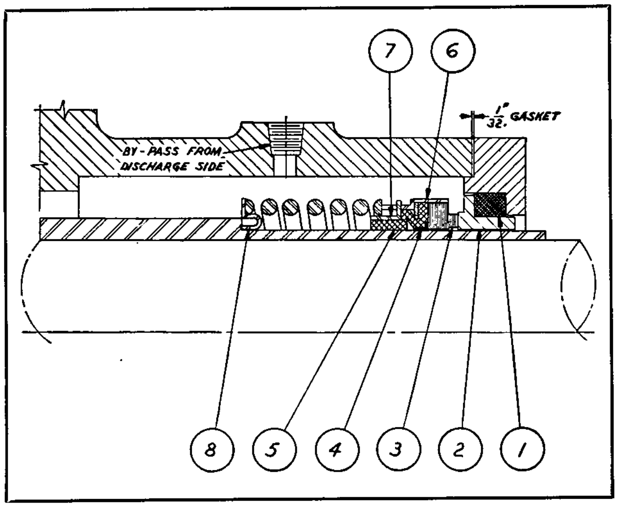

Fig. 14 — Crane mechanical shaft seal.

Item	Part	Item	Part
1	Synthetic Rubber Seat	5	Flexible Synthetic Rubber Bellows
2	Floating Seat	6	Retainer Shell
3	Sealing Washer	7	Driving Band
4	Ferrule	8	Spring Holder

a. Dismantling

a. Back off gland bolts, freeing gland plates.

b. Remove rotating element from pump and take off bearing and shaft nuts.

c. Remove floating seat (Item 2) and sealing washer (Item 3). (The washer was installed at the factory, using an adhesive which joins it to the bellows. This joint must be broken.) Take care not to drop these parts or scratch their lapped faces.

d. Do not disturb the bellows unless it needs replacement, as it will have adhered to the sleeve if the seal has been in use for any length of time and will be damaged if moved. If the bellows need replacement force it off the sleeve.

e. Remove spring, spring holder and remaining parts. If the seal uses a set collar, measure for its location before removing so as to correctly locate new collar.

b. Assembly

a. Clean up all the parts and lightly oil the surface of the floating seat and the shaft sleeve (light oil — not grease).

b. Make sure that item (1) is tight against shoulder of item (2) with rounded outer edge to the rear to facilitate insertion. The ring is assembled this way when shipped. Push the assembly of these two pieces firmly into the cavity in the gland plate and seat it squarely. DO NOT push on lapped face of floating seat.

c. Put spring holder or set collar in place. If set collar is used locate collar per dimension determined when dismantling.

d. Put the remainder of the seal parts on the sleeve as an assembly. When the extended length of the seal assembly is longer than the undercut portion of the sleeve or than the distance from collar to end of sleeve, compress the spring beforehand and tie together with string. The string should be removed after installation of element in lower half of casing and partial tightening of gland bolts. Be sure there are no burrs on the sleeve to harm the bellows and that the new bellows is pushed straight on the sleeve.

e. Cut casing joint gasket approximately 1/8" too long at ends of stuffing box. The oversize portion should be cut away with a sharp knife or razor blade after the upper half-casing is bolted down.

f. Reconditioning of used seal face or complete seals that are in reasonably good conditions is possible. Consult factory.

2. Dura Seal Mechanical Seal (Fig. 15)

Figure 15 shows the construction of a Dura Seal mechanical seal. The Dura Seal must be lubricated by water from the discharge side of the pump except when special liquid is being handled. The gland insert can be lubricated and cooled externally if necessary. For full information on this method of cooling consult the factory.

The Dura Seal must be assembled and adjusted on the shaft with the upper half of the pump casing in place. The adjustment is made by setting the collar (Item 5) to dimension A. The dimension will be contained in the special instructions attached to the pump. The parts are assembled in sequence, however, the gland (Item 1) should not be tightened until the upper half of the casing has been bolted in place. The type of shaft packing (Item P) varies with the application.

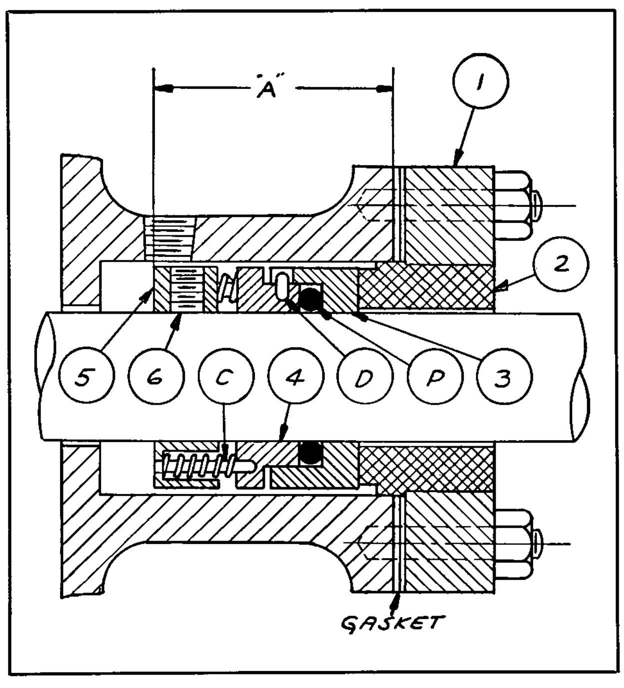

Fig. 15 — Dura Seal mechanical seal.

Item	Part	Item	Part
1	Gland	5	Collar
2	Gland Insert	6	Set Screws
3	Seal Ring	C	Springs
4	Compression Ring	D	Drive Pins
		P	Shaft Packing

6. Bearing Adjustment

A. BABBITT BEARINGS, BALL BEARINGS AND CARBON BEARINGS

These types of bearings are not made for adjustment. These bearings are to be replaced when worn or damaged.

B. KINGSBURY TYPE THRUST BEARINGS (Fig. 16)

This bearing is an oil thrust bearing of the pivoted shoe type. When it is in operation the bearing shoes and thrust sleeve bearing disc are separated by an oil film so there is no metallic contact, consequently minimum wear.

The rotating thrust disc is held perpendicular to the shaft by means of a long shaft sleeve of which it is a part.

Stationary pivoted thrust bearing shoes are so constructed that they are free to tilt both radially and tangentially so that when the bearing is in operation the bearing faces of the shoes lie slightly inclined to the disc and the oil films between them are slightly wedge shaped. The mean thickness of this oil film is rarely more than .002 inches.

The total clearance between the thrust bearing disc and the thrust bearing shoes should be from .010 inches to .015 inches and can be adjusted as follows:

Remove the upper half of the split bearing cap and the screw holding the lock clip. Then screw the adjusting ring until the thrust shoes are up against the thrust disc. The adjusting ring should then be screwed back one to two full notches. One notch on the adjusting ring is equivalent to .005 inches. The bearing adjustments are not critical, although too little clearance results in heating, while excessive clearance allows the pump rotating element to float and may result in a bearing knock.

Rapid wear of packing in the stuffing boxes is sometimes caused by too much clearance between the thrust bearing disc and the bearing shoes. This is due to the axial movement of the floating rotating element and is noticed particularly when the shaft sleeves in the stuffing boxes are scored, making it necessary to repack the stuffing boxes frequently with new packing. If the clearance is properly adjusted there will be no float of the rotating element and consequently reduced wear on packing and shaft sleeves.

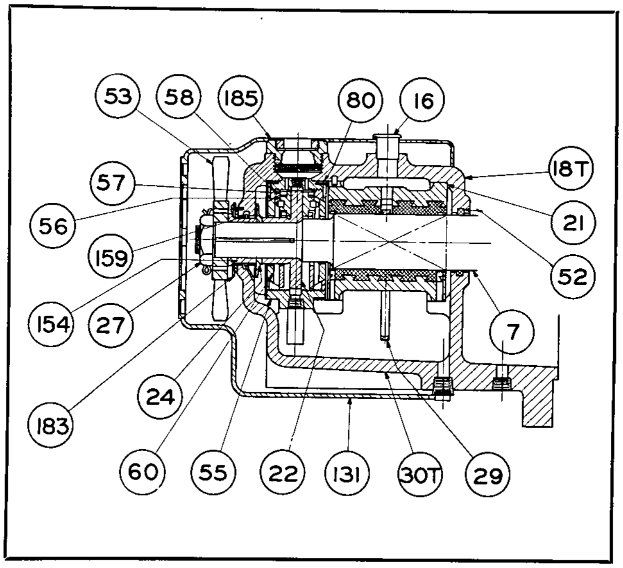

Fig. 16 — Kingsbury type thrust bearing.

Care should be taken when removing the thrust disc and bearing shoes not to get the bearing faces scored as any roughness results in heating. As any foreign matter in the oil may get between the bearing shoes and thrust disc and score them due to the close running clearance, it is recommended that the oil be changed periodically and that before new oil is put in, the bearing and bearing housing should be thoroughly flushed with kerosene to remove any grit that may have collected.

When assembling the bearing, care should be taken to replace the housing, so that the arrow points in the same direction as the arrow on the pump.

It should be noted again that the *BEARING MUST ALWAYS BE INDIVIDUALLY FILLED BEFORE STARTING THE UNIT FOR THE FIRST TIME, AFTER THE BEARINGS HAVE BEEN DRAINED.*

7. Bearing Lubrication

A. BEARINGS WITH OIL PUMP AND COOLER — WITH TANK

Before starting the unit, the bearings should be thoroughly cleaned by washing with kerosene. They should then be filled with good grade filtered mineral oil, SAE-10, of approximately 150 Saybolt viscosity at 100 F. The oil tank must be filled and the oil pump primed by pouring oil in at the tee near the pump suction.

Even with an oil circulating system the *bearings must also be filled individually until they overflow into the oil tank.*

When the pump is first started the operator should make sure the oil rings are turning freely. They may be observed through the oil holes in the bearing caps.

After the unit is in operation, the valve to the inlet of the thrust bearing should be regulated to allow a generous supply of oil to show in the sight at the top of the thrust bearing. On some units, orifices of predetermined size are used, which eliminate any further adjustment. The relief valve should be adjusted to hold a pressure of about 15 lb.

After the unit is in operation it may be necessary to add a small amount of oil to bring the level back to the mark on the gauge glass.

In operation the oil pump takes oil from the tank, pumps it through the cooler and then back into the bearings. A relief valve is provided from the discharge of the cooler to the suction of the pump to by-pass oil in case the flow into the bearings is shut off.

B. OIL LUBRICATED BALL, SLEEVE, AIR-COOLED KINGSBURY BEARINGS

Before starting the bearings should be thoroughly flushed out with kerosene, as dirt and foreign substances may get in during shipment or erection. The bearing housing should be filled with a good grade of mineral oil, SAE-10, of approximately 150 Saybolt Viscosity at 100 degrees F. When the pump is first started, the operator should make sure that the oil rings are turning freely. They may be watched through the oil holes in the bearing caps. The oil rings should be checked periodically during the first hour of operation to make certain that they continue to turn freely.

C. GREASE LUBRICATED BALL BEARINGS

Grease lubricated ball bearings are packed with grease at the factory and usually require no attention before starting, provided the pump has been stored in a clean dry place prior to its first operation. After the pump has been started, the bearings should be watched the first hour or so to see that they are operating properly.

The importance of proper lubrication of ball-bearings cannot be overemphasized. It is difficult to say how often a ball bearing should be greased since this depends on the conditions of operation. For average operating conditions it is recommended that grease be added at intervals of three to six months. Do not overgrease, as overgreasing will cause overheating.

Great care must be exercised to keep the housing perfectly clean and only clean grease should be used. Foreign solids or liquids in the bearing housing may completely destroy the bearings in a short time. When cleaning ball bearings, flush with gasoline or kerosene and use clean tools and cloths. Do not use waste.

8. Partial List of Approved Greases

Recommended for Centrifugal Pumps equipped with ANTI-FRICTION BEARINGS.

The grease should be a well-manufactured product, composed of a high-grade soda soap and a refined, clean mineral oil. It should be free from corrosive matter, grit, rosin, talc, mica, clay or fillers of any kind and conform to the following specifications:

Consistency (Karnes-Maag Method)
Ash Maximum 2%
20 MM to 35 MM at 750° F
Moisture Maximum 2%

Corrosion — A bright copper plate should show no discoloration when submerged in the grease for 24 hours at normal room temperature.

The mineral oil from which the grease is compounded should conform to the following tests:

Flash	Minimum	340 F
Fire	Minimum	380 F
Viscosity at 100 F	Saybolt Universal	200 sec. Min
Cold Test (Pour)	Maximum	Plus 30 F

Atlantic Refining Co.	Philadelphia, Pa.	Atlantic Lubri.—63
Associated Oil Co.	Associated, Calif.	Lassen No. 2 Grease
Cities Service	N.Y., N.Y. and Chicago, Ill.	Trojan—M3
Continental Oil Co.	Ponca City, Okla.	Conoco Robalub No. 33
Fiske Bros. Refining Co.	Toledo, Ohio	No. 220 A Grease
Gulf Refining Co.	Pittsburgh, Pa.	H & M Grease
Houghton, E. F. & Co.	Philadelphia, Pa.	F-9 Absorbed Oil
Houghton, E. F. & Co.	Philadelphia, Pa.	No. 1 Absorbed Oil
Hulbert Oil & Grease Co.	Philadelphia, Pa.	No. 315 Grease
Humble Oil & Refining Co.	Houston, Texas	Andok Lubricant-B
Imperial Oil Co., Ltd.	Toronto, Ont., Canada	Andok Lubricant-B
Keystone Lubricating Co.	Philadelphia, Pa.	Keystone No. 44
Lubriko Co.	Philadelphia, Pa.	Lubriko M-6
Lubri-zol Corp.	Cleveland, Ohio	Anti-Friction Brg. Grs.
N.Y. & N.Y. Lub. Co.	New York, N. Y.	F-926 Non-Fluid Oil
N.Y. & N.J. Lub. Co.	New York, N. Y.	Grease No. S-58

Oil Kraft, Inc.	Cincinnati, Ohio	Elec. Motor Grease—Hvy.
Pure Oil Co.	Cincinnati, Ohio	Purolene Brg. Grease
Penola, Inc.	Pittsburgh, Pa.	Andok Lubricant-B
Pennsylvania Oil & Mfg. Co.	Elizabeth, N. J.	No. 777 BR Lub.
Phillips Petroleum Co.	Bartlesville, Ohio	Osirisa
Sinclair Refining Co.	New York, N. Y.	Brg. Grease "A.F."
Socony-Vacuum Corp.	New York, N. Y.	Gargoyle Grs. BRB No. 3
Standard Oil Co. of Ohio	Cleveland, Ohio	Polarine Brg. Compound
Standard Oil Co. of Indiana	Chicago, Ill.	Superla, 2X Grease
Standard Oil Co. of New Jersey	New York, N. Y.	Andok Lubricant-B
Standard Oil Co. of Calif.	San Francisco, Calif.	Zerolene Fibre Grease
Standard Oil Co. of Penna.	Pittsburgh, Pa.	Andok Lubricant-B
Standard Oil Co. of Kentucky	Louisville, Ky.	Andok Lubricant-B
Sun Oil Co.	Philadelphia, Pa.	Sun Amber Grease
Texas Co.	New York, N. Y.	Starfak No. 2
Tidewater Associated Oil	New York, N. Y.	Tycol No. 374
Union Oil Co. of Calif.	Los Angeles, Calif.	Union Ball Brg. Grease
Valvolene Oil Co.	Cincinnati, Ohio	Anti-Friction Brg. Grease No. 350

A. GEAR TYPE COUPLINGS

After the couplings have been closed, they must be lubricated through the holes in the coupling flange.

The coupling should be lubricated with a good fluid lubricant, no lighter than heavy engine oil (SAE-70) or heavier than heavy gear oil (1000 seconds Saybolt Viscosity at 212 degrees F.) DO NOT USE GREASE.

The approximate capacities are as follows:

Coupling Bore	*Oil Capacity* — In Pints
1½″	⅛
2″	⅙
2½″	5/16
3″	½
3½″	¾
4″	1¼

B. FALK GRID TYPE COUPLINGS

After the gridmembers have been inserted in the grooves, pack the spaces between and around the grid with as much lubricant as possible. Fill coupling to absolute limit — this is essential to proper functioning. Scrape or wipe excess lubricant flush with top gridmember, clean inside of cover. Draw the cover up and fasten in place with bolts provided. Use nail or small screw driver under neoprene seal rings for venting during assembly of cover. Add lubricant with grease gun. Make sure that the neoprene seals are squarely seated on hubs and not pinched under cover. Lubricate at least once every 6 months.

1. Recommended Lubricants

A number of lubricants have been tested for nonfluidity at temperatures up to 150 degrees F, and the following are considered suitable for the lubrication of Falk Steelflex couplings.

Alemite — No. 339
Continental Oil Co. — Robalube No. 25
E. F. Houghton — Absorbed Oil No. 042
Fiske Bros. Refining Co. — Lubriplate No. 315
Gulf — Precision Grease No. 2
Kindall Refining Co. — Wheel Bearing Grease
Keystone — No. 44
McCall-Frontenac Oil Co., Ltd. — Texaco Marfak No. 2 Heavy Duty
N.Y. & N.J. Lubricating Co. — Non-fluid Oil K-485
Ohio Oil Co. — No. 1323 Marathon XT
Phillips Petroleum — Kyak "B" Industrial Bearing Grease
Sinclair Refining Co. — Opaline Universal Grease
Shell Oil Co. — EXL No. 3
Socony-Vacuum — Gargoyle BRB Grease No. 3
Standard Oil Co. of Calif. — Calol Crank Pin Grease No. 2
Standard Oil Co. (Indiana) — Standard Wheel Bearing Grease — Med.
Standard Oil Co. (New Jersey) — Esso Fibre Grease
Standard Oil Co. (Ohio) — 200 E. Grease
Sun Oil Co. — Universal Joint Special Heavy
The Texas Company — Marfak No. 2 Heavy Duty
Tide Water Co. — Grease No. 272

9. Balancing

A. METHOD OF BALANCING MULTI-STAGE PUMPS

Most multi-stage pumps are built with double suction impellers so that they are in hydraulic balance under all conditions.

Type HYC two stage pumps, Condensate and Barrel pumps, are built with the runners arranged back to back so that the end thrust of one is balanced by that of the other.

Other multi-stage pumps are built with single suction impellers and there is an unbalanced thrust. The device for balancing this thrust is an original feature of Allis-Chalmers Type "ST" multi-stage pumps, balancing the thrust hydraulically, thus eliminating large and complicated thrust bearings. The automatic hydraulic balancing disc, as it is called, is a feature of proven value.

The unbalanced thrust is toward the suction end of the pump, and is balanced by a counter-pressure in the opposite direction, automatically maintained in proportion against the balancing disc.

B. SINGLE ACTION BALANCE DISC USED WITH "ST" PUMPS (Fig. 17)

The balancing disc (4) is fixed on the shaft back of the last stage impeller, and the face of the disc rotates normally close to the seat (2) with a film of water in the clearance space (3) separating the disc and seat. The hub of the balancing disc extends through the thrust plate (1) which is stationary in the casing, leaving an annular opening (5) between the hub of the balancing disc and the thrust plate.

1. The Operation is as Follows

The pump when operating generates a total pressure (p) which builds up a pressure slightly less than (p) in the pressure chamber (6) by leakage through the space (5). This pressure acts against the balancing piston (4) to counterbalance the end thrust, which is in the opposite direction. If this balancing force overbalances the end thrust, the leakage joint (3) opens slightly, allowing the escape of a small amount of water, which is piped back to the suction, thereby reducing the pressure in the space (6) and allowing the shaft to return to a position of equilibrium. This slight end movement of the shaft is only noticeable in starting up, as the shaft takes up and remains in a balanced condition when the pump is operating.

When renewing a balancing piston, place the disc on the shaft and in contact with the thrust plate. Then set the collar on opposite end of shaft $\frac{1}{32}$" from end of bearing shell.

C. DOUBLE ACTING BALANCING DISC USED WITH TYPE "ST" PUMPS (Fig. 18)

The balancing disc is fixed on the shaft back of the last stage impeller, and the face of the disc normally rotates close to the seat (B) with a film of water between. The balance bushing (F) is held in the casing so that there is a small clearance (E) between it and the balancing disc.

1. The Operation is as follows

When the pump is operating, the total discharge pressure in (A) acts against the face of the balance disc, pushing it to the right and counterbalancing the end thrust. This moves the disc away from its seat, reducing the clearance (E) between the balance disc and the bushing, and allowing pressure to be built up in the balance chamber (D). Pressure here, acting with the unbalanced thrust, pushes the disc back, increasing the clearance (E), thus reducing the pressure in (D) until the point of equilibrium is reached. The water flowing out through (E) escapes along the outside of the shaft sleeve to the chamber (G) from whence it is piped back to the suction.

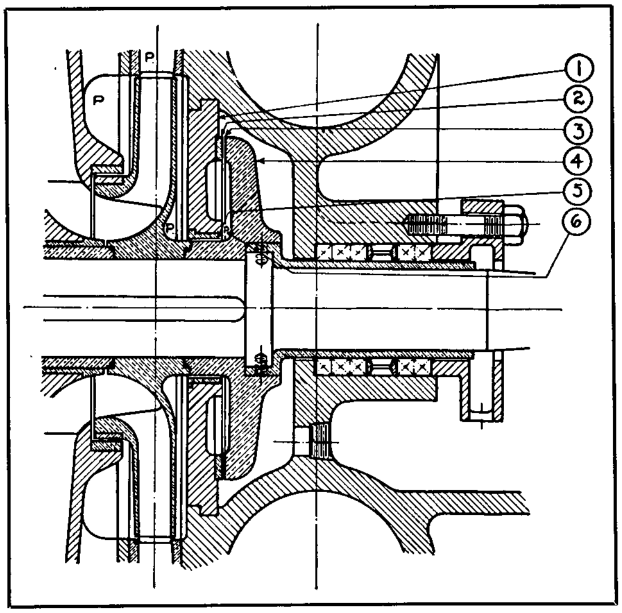

Fig. 17 — Single action balance disc.

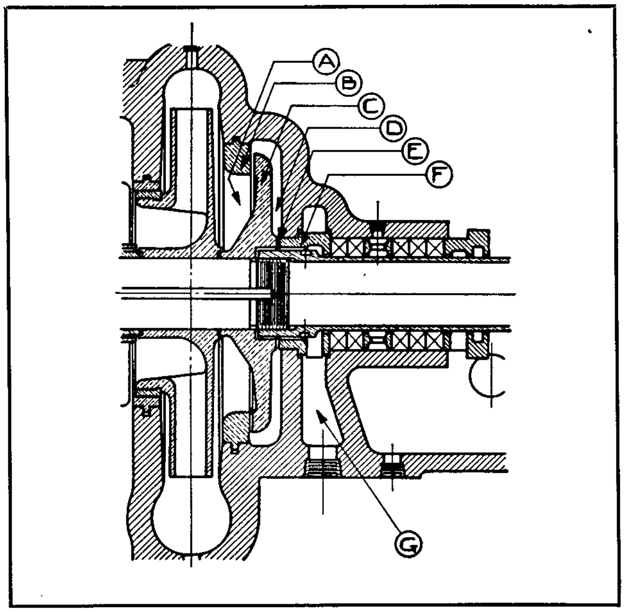

Fig. 18 — Double action balance disc.

CAUTION

When replacing the upper half casing on a multi-stage balance disc type pump care must be taken that the gasket is not torn around the thrust plate "B" joint. Leakage through the joint at this point prevents the balance disc from working properly as pressure builds up in the balance chamber (D) behind the disc (C), butting down the differential pressure for which the pump was designed, and allowing the disc to rub on the plate. This wear can be observed by the shaft gradually moving toward the first stage. The wear usually is not extremely rapid, but noting position of shaft at intervals of a week or so will usually indicate if pump has been properly assembled with satisfactory gasket at the joint. Care should be taken that the balance disc runs true to the face of the balance plate. When necessary, grind the disc to the plate, using a fine abrasive compound. Remove all compound after grinding.

10. To Change Rotation

The rotation of all multi-stage pumps cannot be changed. Type "M" and "MM" pumps can have their rotation reversed, but the *Doubleton,* "Barrel" and "Condensate" pumps, due to their particular construction, cannot have their rotation changed. To change rotation of multi-stage pumps do the following:

Remove the coupling bolts.

Remove bolts holding the pump to the baseplate and reverse the position of the pump so that the coupling will be on the outboard end.

Remove the rotating element from the pump casing.

Dismantle rotating element. Impellers should be removed from both ends of the shaft. Where space does not permit the removal of casing rings they can be left in place, and pressure to remove the impeller can be exerted directly against the casing ring. The position of the last impeller must be marked carefully on the shaft before it is removed so that when it is replaced the shaft position with respect to the casing will be retained. Then proceed to remove impeller as outlined previously in this book under the heading "Dismantling Rotating Element."

Reassemble the rotating element. Turn the impellers around so that the vanes will face in the opposite direction. Follow instructions as outlined in the chapter "Reassembling Rotating Element." Do not forget shaft sleeve packing.

As the shaft will now rotate in the opposite direction, the shaft sleeve nuts will tend to loosen. To overcome this difficulty, it is customary to lock the nuts with a small set screw, going through the nut and into the shaft to a depth of about $\frac{1}{16}''$. Peen the edge of the hole after the set screw is tight, so it cannot work out.

Reassemble the parts completely.

Place the rotating element in lathe and check run-out. Not more than .003″ total deflection is allowed. If any difficulty is experienced, call the factory for advice.

Replace rotating element in casing and adjust thrust bearing, if necessary, to center the impellers in the pump volutes.

It may be necessary to switch bearing housings or bearing brackets, depending upon the type of bearing used.

Carefully realign pump and drive before bolting and dowelling pump to baseplate. Recheck the alignment before dowelling the driver.

Reverse direction of driver and check with arrow on pump casing before bolting-up coupling.

11. Maintenance

Regular inspection should be made of the unit. Among the points to be checked are the following:

1. The stuffing boxes should be checked to see that leakage is not excessive, but is sufficient for lubrication of packing.
2. Inspect bearings for proper lubrication, and inspect oil for cleanliness, and for evidence of water which may collect at the bottom of bearings and oil tank. The entire lubricating system should be cleaned when the oil becomes dirty.
3. Alignment should be checked occasionally.
4. Gauges should be celibrated and then readings checked to see that the pump is operating at near the designed head.
5. Pipe connections, main joint flanges, etc., should be watched for leakage.
6. Protective devices should be tested regularly.

Operating conditions vary so widely that to recommend one schedule of preventative maintenance for all pumps is not possible. Yet, some sort of regular inspection should be followed on any mechanical equipment. Centrifugal pumps are no exception. It is suggested a record be kept of the periodic inspections and maintenance on your pump. This recognition of maintenance procedure will keep your pumps in good working condition, and will prevent costly breakdowns.

One of the best rules to follow in the proper maintenance of your centrifugal pumps is to keep a record of the *actual operating hours.* Then, after a predetermined period of operation has elapsed, the pump should be given a thorough inspection. The length of this operating period will vary with different types of pumps and different applications, and can be determined from experience. New equipment, however, should be examined after a relatively short period of operation. The next inspection period can be lengthened somewhat. This system can be followed until a maximum period of operation is reached, which should be considered the operating schedule between inspections.

The following timetable is based on continuous pump operation, but can also serve as a reliable pattern for all practicable purposes. (Approximately 8,760 hours has been determined as equivalent to one year's operation.)

MAINTENANCE TIMETABLE

Every Month	Check bearing temperature with a thermometer, not by hand. If ball or roller bearings are running hot, it may be the result of too much oil or grease. If sleeve bearings are running too hot, they may need more oil, or the lubricant may be heavier than that recommended. If changing the lubricant does not correct the condition, disassemble and inspect the bearing. Alignment of pump and driver should also be checked.
Every 3 Months	Drain oil and wash out oil wells and bearings with kerosene. Check sleeve bearing oil rings. They should turn freely with the shaft. Repair or replace if defective. Refill with recommended grade of lubricant. Check grease lubricated bearings for saponification. This condition is usually incurred by the infiltration of water or other fluid past the bearing shaft seals, and can be noticed immediately upon inspection, since it gives the grease a whitish color. Wash out the bearings with kerosene and replace the grease with the proper type as recommended. Measure bearings for wear. Replace if necessary. Generally allow .002 inch clearance for each inch or fraction thereof of shaft journal diameter, plus .001 inch. A good method of checking clearance is to clamp a fuse wire between the upper bearing shell and the shaft, and measure the flattened lead wire thickness with a micrometer. When the fuse wire is inserted, the bearing should be bolted down as for normal operation of the pump. The flattened wire will then correspond to the total bearing clearance. Caution: *Use a fuse wire of no more than 10 thousandths thickness over the estimated bearing clearance.*
Every 6 Months	Check the packing and replace if necessary. Use the grade recommended. Be sure the seal cages are centered in the stuffing box at the entrance of water seal piping. Check shaft sleeve for scoring. Scoring accelerates packing wear, therefore, replace scored sleeves. Check alignment of pump and motor. Shim up units if necessary. If misalignment recurs frequently, inspect the entire piping system. Unbolt piping at suction and discharge flanges to see if it springs away, thereby indicating strain on the casing. Inspect all piping supports for soundness and effective support of load.
Every Year	Remove the rotating element. Inspect thoroughly for wear, and order replacement parts if necessary. Check wearing ring clearances. Generally, wearing ring clearances should be approximately no more than .003 inch per inch on the diameter of wearing rings. Remove any deposit or scaling. Clean out the water seal piping. Measure total dynamic suction and discharge head as a test of pipe condition. Record the figures and compare them with the figures of the next test. This is important especially where the fluid being pumped tends to form a deposit on internal surfaces. Inspect foot valves and check valves, especially the check valve which safeguards against water hammer when the pump stops. A faulty foot or check valve will reflect also in poor performance of the pump while in operation.

We recommend your keeping a permanent record of your pump and of pump performance on page 21 of this book. Additional copies of this page are available upon request.

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Serial No. ______ Size and Type ______ Make ______

Cust. Order No. ______ Date Installed ______

PUMP RATING

Capacity ______ Gpm

Total Head ______ Ft

Suction (+ or —) Hd. ______ Ft

Speed ______ Rpm

Liquid ______

Temp. ______

Spec. Grav. ______

Viscosity ______

Impeller Dia. ______ In

STUFFING BOX

Size: O. D. ______ I. D. ______

Packing ______

No. Rings ______

Packing Mfgr. ______

Packing No. ______

BEARINGS

Coupling End ______

Type ______ Size ______

Outboard End ______

Type ______ Size ______

PUMP MATERIALS

Casing ______

Casing Rings ______

Impeller ______

Impeller Rings ______

Shaft ______

Shaft Sleeves ______

Coupling ______

Casing Gasket Type ______

Thickness ______ In

Nominal Wearing Ring Clearance ______ In

Driver ______ Make ______ Serial No. ______ Type ______

Hp ______ Rpm ______ Frame ______ AC or DC ______

Volts ______ Phase ______ Cycles ______

Inlet Steam, Psi G ______ Total Temp F ______ Exhaust, Psi G ______

Control: Type ______ Make ______

INSPECTION AND REPAIRS

Inspected		Out of Service	Back In Service	Repairs	Cost	Remarks
Date	By					

This record will show at a glance the life of any parts replaced and any improvement due to substitute materials. When contemplating the purchase of additional equipment or replacement units for similar service, this record will be an invaluable guide to the owner and the manufacturer.

12. Type M Multi-Stage Pumps

The Type "M" Centrifugal pump is a double suction, multi-stage unit designed for pumping liquids against high heads.

The use of double suction impellers equalizes end thrust and eliminates the use of internal balancing arrangements.

Each stage of the casing has a spiral volute and between stages the liquid flows from one volute into an exceptionally long diffusion nozzle and then into a long sweep return bend to the inlet passages of the following stage. This construction results in maximum practical regain of pressure between stages as the liquid is directed along smooth flow lines without sudden changes in velocity.

The pressure on the stuffing boxes is equalized and kept within reasonable limits.

See Figure pertaining to Specific Size Pump.

A. CONSTRUCTION

CASING (1) is horizontally split, with the suction and discharge nozzles in the lower half. Feet are provided on the lower half casing located near the horizontal centerline for supporting the pump on the base. The volute passages surrounding the impeller and the water passages extending from the volutes around to the succeeding impeller inlets are cast integral in the lower half casing. At the horizontal joint, the casing is provided with heavy flanges for bolting the two casing halves together.

IMPELLERS (2) are of the double suction enclosed type, and are accurately machined, finished, and carefully balanced.

CASING RINGS (3) are held in the casing surrounding the impeller inlets by means of a self-locking tongue and groove arrangement. Companion IMPELLER RINGS (4) are fastened to the impellers surrounding inlet openings and have a close running clearance with the casing rings.

SHAFTS (7) are made of steel, accurately machined and ground to close tolerances. They are ample to transmit the maximum power required.

CASING BUSHINGS (8). A long pressure-reducing bushing is provided in the casing between the last stage impeller and the stuffing box. This restricts the passage between the bushing and the shaft sleeve causing a pressure drop in the space between the bushing and the stuffing box. This reduces the pressure on the high pressure packing, greatly reducing leakage. The suction end bushing protects the casing from wear and reduces the pressure on the stuffing box when the pump is required to operate with abnormally high suction pressure.

SHAFT SLEEVES (9) are provided through the stuffing boxes and interstage sleeves (35) between the impellers. Shaft Sleeve Nuts (15) maintain the position of the sleeves and impellers and also act as a deflector to keep the liquid being pumped from getting into the bearing housings.

STUFFING BOXES AND GLANDS (14) are provided where the shaft passes through the casing. The stuffing boxes are deep enough for ample high grade packing (12) and are provided with seal cages (13). Glands are of the split type. Pumps built for handling high temperature liquids have stuffing boxes arranged for water cooling.

INTERSTAGE BUSHINGS (34) are provided where the shaft passes through the casing between stages. These bushings reduce leakage between stages to a minimum.

Type M Pumps With Grease Lubricated Bearings (Fig. 19)

BEARING CAPS (18). On these pumps the lower portion of the bearing bracket is cast integral with the lower half casing and caps fit tightly on these brackets.

BALL BEARING HOUSINGS (25C and 25T) with BEARING END COVERS (28C and 28T) are held in place in the brackets by means of a tongue and groove. They are provided with fittings for grease lubrication of the bearings.

BALL BEARINGS (26) are of the double row type of ample size for any pumping condition and are held in place on the shaft by LOCKING NUTS (27). The outboard bearing is held in a fixed position in the housing so as to carry any unbalanced thrust which the pump might develop. The coupling end bearing mounting is designed to permit axial expansion of the shaft due to temperature variations. The bearings and housings lift out of the pump without rotating element.

INTERSTAGE DIAPHRAGM (142) is provided in these pumps, instead of Interstage Bushing (34) where the shaft passes through the casing between stages, reducing leakage to a minimum.

Type M Pumps With Oil Lubricated Bearings (Fig. 20)

BALL BEARINGS (26) are of the double row type of ample size for any pumping condition and are held in place on the shaft by LOCKING NUTS (27). The outboard bearing is held in a fixed position in the housing so as to carry any unbalanced thrust which the pump might develop. The coupling end bearing mounting is designed to permit axial expansion of the shaft due to temperature variations. The assembled bearings and adaptors lift out of the pump with the rotating element. On the 6 x 4 MM-4 a sleeve type bearing is used on the coupling end.

OIL RINGS (29) Bronze oil rings are provided to supply the proper amount of oil to pump bearings.

BEARING HOUSINGS (30) are independent of the stuffing boxes and are bolted to the lower half casing. The BEARING CAPS (18) fit tightly on the BEARING HOUSINGS and the ADAPTERS (87C and 87T), with their respective RETAINING RINGS (86), are held in place by means of a tongue and groove type of construction.

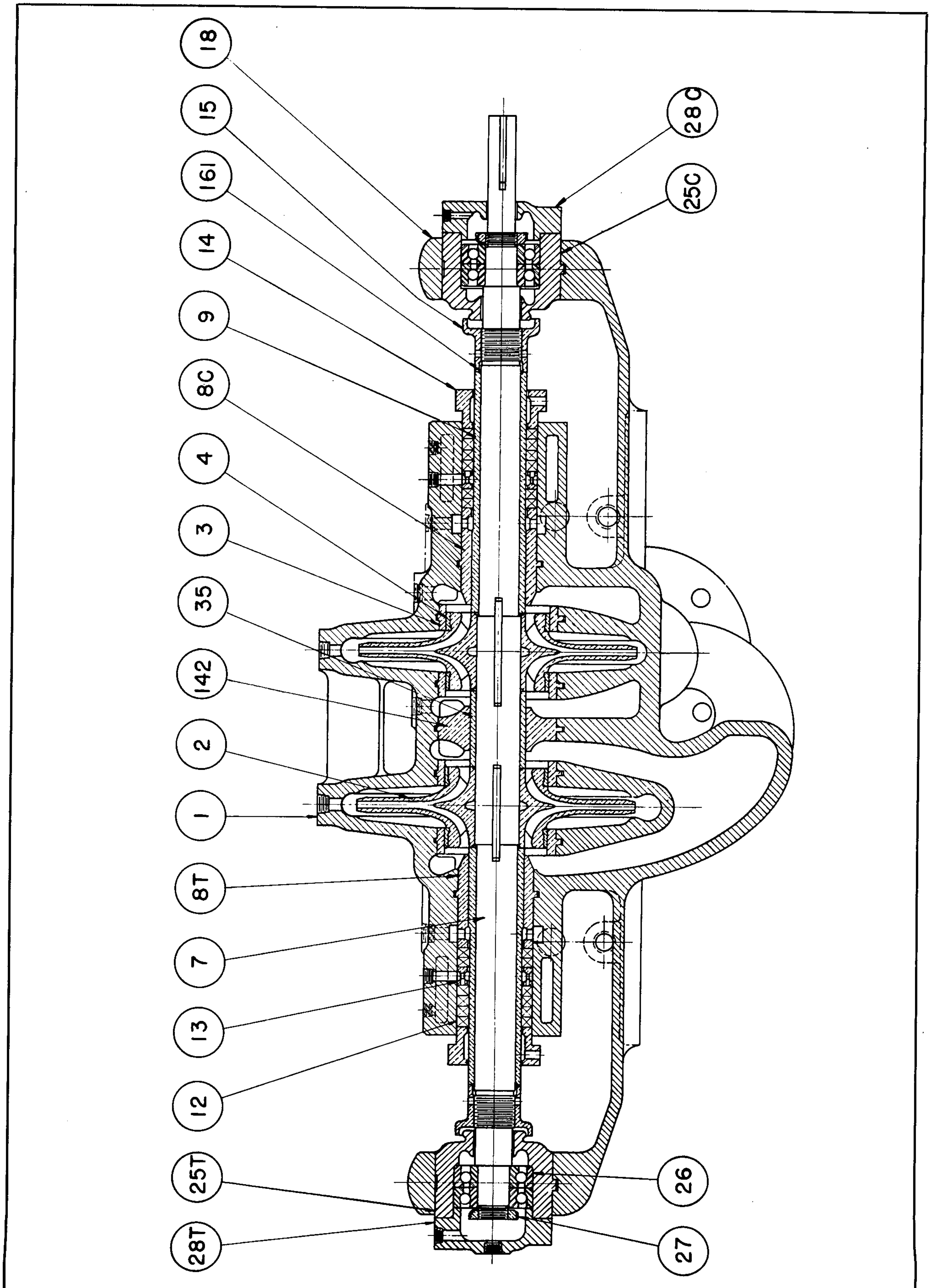

Fig. 19 — Type M Pump with Grease Lubricated Bearings.

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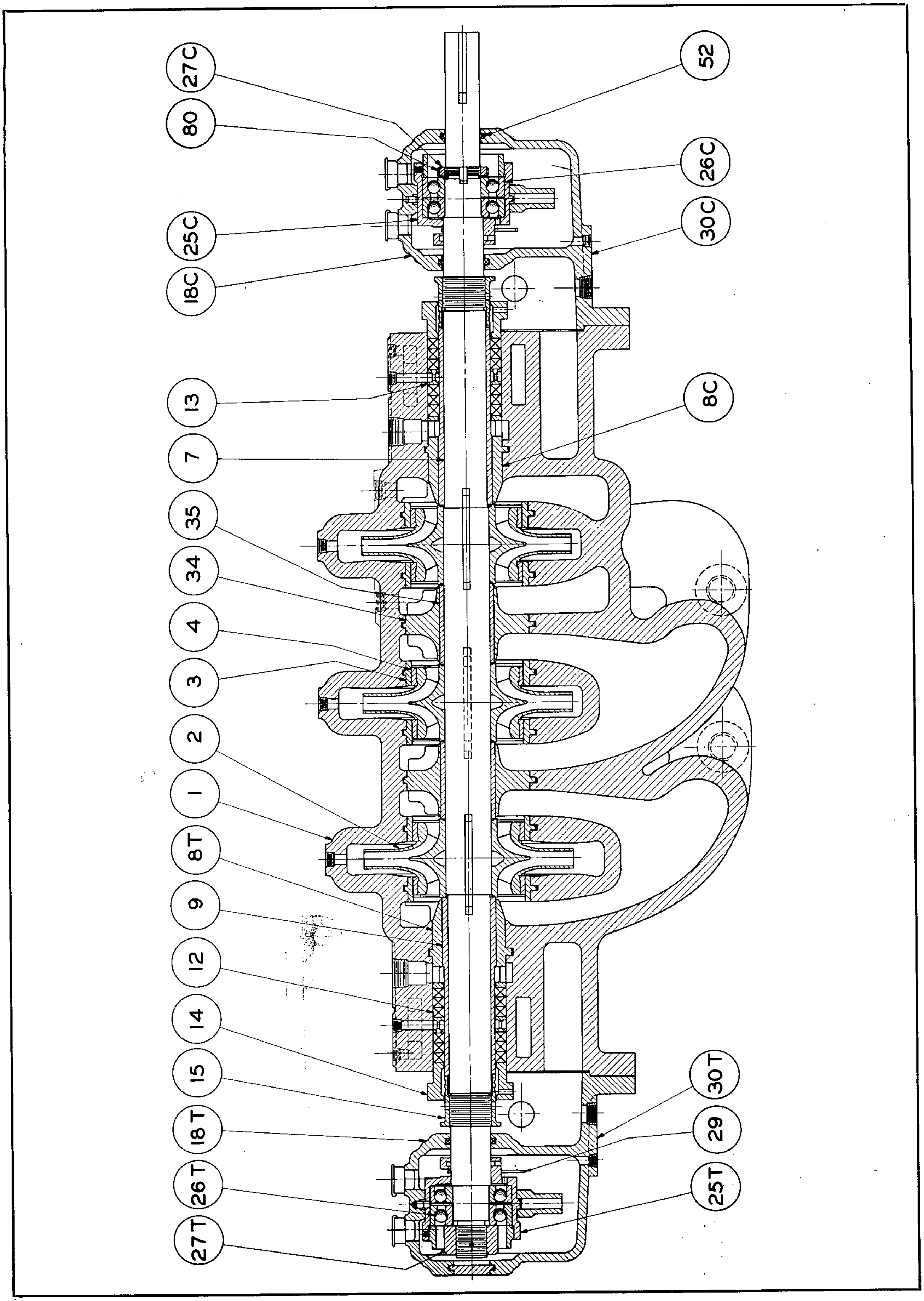

Fig. 20 — Type M Pump with Oil Lubricated Bearings.

Type M Pumps With Kingsbury Thrust Bearings (Figs. 21, 22)

BEARINGS are of the split shell, babbitt lined type, held in cast iron housings bolted to the flanges on the ends of the casing. The outboard bearing will be a combined radial bearing of the sleeve type and a thrust bearing of the pivoted shoe Kingsbury type. The Kingsbury bearing, on account of the double suction impeller construction of the pump, has very little unbalanced thrust to carry and serves principally to maintain the impellers' proper location in their respective volutes.

LUBRICATION of the bearings is by means of bronze oiling rings which supply the oil to the radial bearings. Positive pressure oiling is obtained for the Kingsbury type thrust shoes by the viscosity pumping action of the thrust disc.

On pumps handling high temperature liquids or operating at high speeds a direct connected positive displacement type oil pump is provided. This pump circulates the oil from the bearing housings through an oil cooler and back to the bearing housings, providing a constant supply of cooled oil to the radial and thrust bearings. When a larger supply of oil is required, an oil tank is also provided. Necessary oil piping and fittings are furnished and assembled to the pump.

On pumps handling cold liquids or operating at low speeds the thrust bearing is air cooled by a fan fastened to the end of the shaft. It blows air over the bearing housing under a split cast aluminum air jacket surrounding the bearing housing and fan.

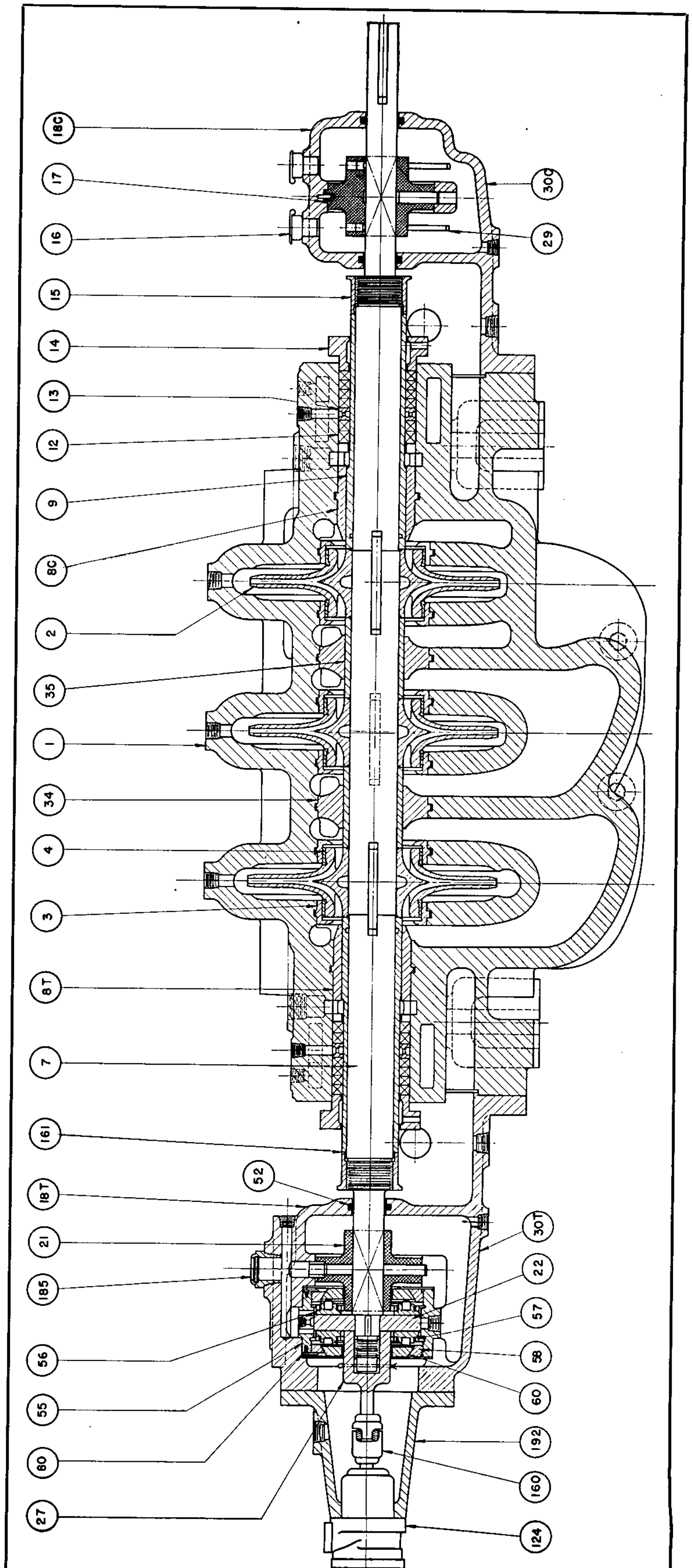

Fig. 21

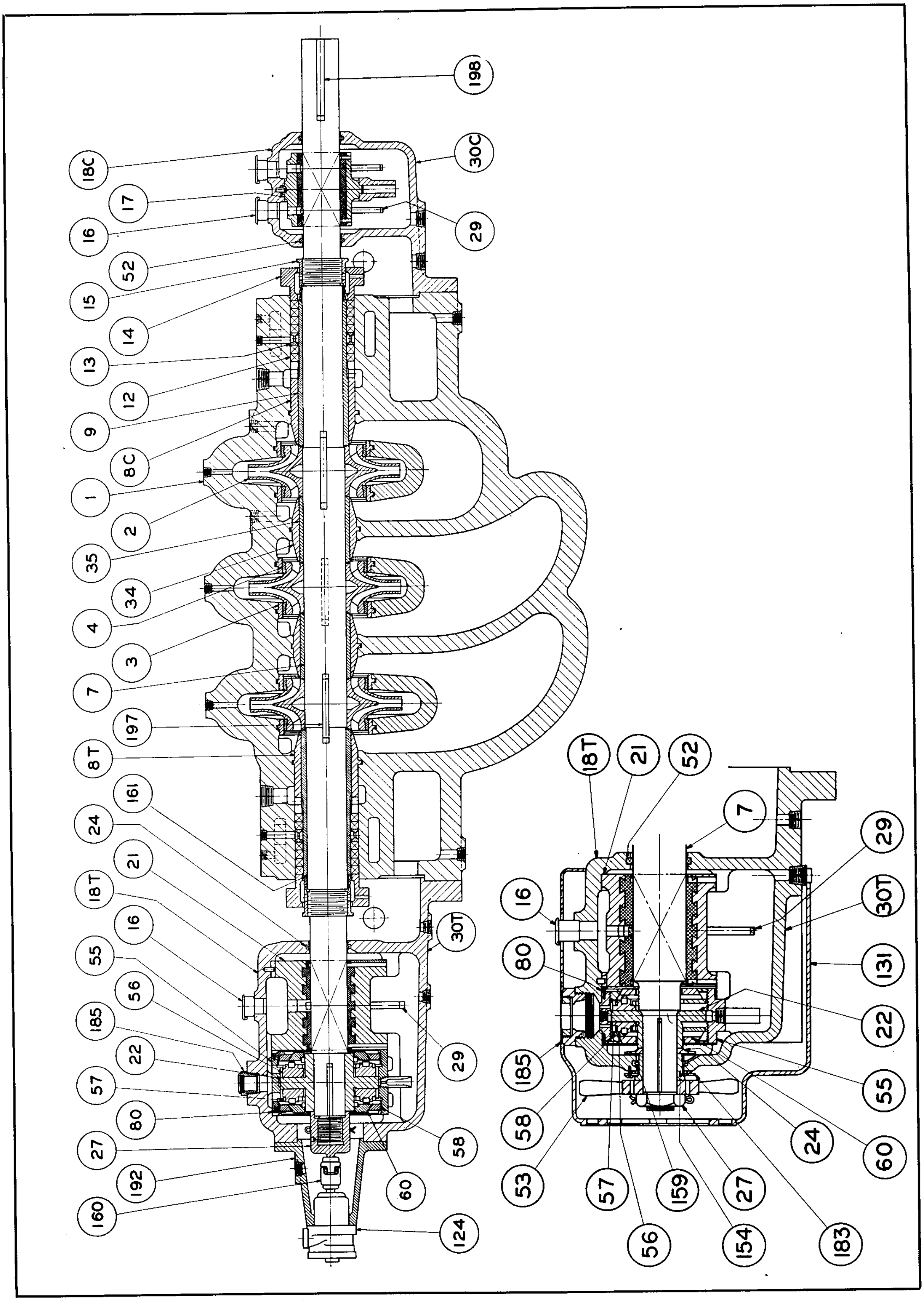

Fig. 22 — Type M Pump with Kingsbury Thrust Bearings.

13. Type B-2 (Fig. 24) and Type HYC (Fig. 23) Pumps

The B-2 stage and HYC type pumps are of the single suction, horizontal shaft type having the casing horizontally split, with the suction and discharge nozzles in the lower half of the casing so that the upper half may be removed without disturbing the piping. This construction permits easy examination of the working parts of the pump. The impellers are placed back to back in the casing, which neutralizes the hydraulic end thrust.

DIRECTION OF ROTATION

Rotation is clockwise when looking at the pump from the driven end. The rotation can be made counter-clockwise on the B-2 but not for the HYC.

CASING (1) is made of ample thickness and is split horizontally. The two halves are furnished with heavy flanges, faced, drilled and bolted together. The upper half of the casing is provided with lifting lugs to facilitate its removal. The lower half of the casing is bolted to the baseplate.

The suction and discharge nozzles extend horizontally and are cast integral with the lower half casing and are provided with flanges for connection to piping.

IMPELLERS (2) are of the single suction enclosed type. The vanes are formed by accurately set cores insuring even thickness and spacing. The impellers are turned to dimension at the outside and the inlet flanges, and bores are key seated for the shaft fit. The water passages are hand finished to a smooth surface and the impellers carefully balanced to prevent vibration and allow minimum clearances.

The impellers are keyed to the shaft and held in position by the shaft sleeves which pass through the stuffing boxes. The shaft sleeves are in turn secured by shaft nuts.

CASING RINGS (3) are held in the casing surrounding the impeller inlets. These rings provide a close running fit in order to minimize the leakage of water at these points. They are made easily renewable so as to allow replacement when worn, thereby maintaining high efficiency.

Impeller rings are used on the HYC type allowing for easy removal.

SHAFT (7) is made of steel, accurately machined and ground and of ample size to transmit the maximum power required. The portions of the shaft coming in contact with the water pumped are protected by shaft sleeves.

SHAFT SLEEVES (9) seal at the impeller hub and at the SHAFT NUTS (15), the other ends of which form deflectors to prevent gland leakage water from flowing out to the bearing housings.

INTERSTAGE DIAPHRAGM (142) and CASING BUSHINGS (8C and 8T) *(Not used on HYC)* are held in the casing by a tongue and groove construction and provide renewable close clearances where the shaft passes through the casing.

STUFFING BOXES are fitted with SPLIT GLANDS (14), are deep enough for ample PACKING (12) and are provided with SEAL CAGES (13).

BALL BEARINGS for B-2 are of the grease lubricated type, provided on each end of the pump shaft where they are secured in place by BALL BEARING RETAINING NUTS (27). The duplex OUTBOARD BEARING (26T) is held in a fixed position in its housing to carry any unbalanced thrust which the pump may develop. The single row INBOARD BEARING (26C) is mounted to allow axial expansion without binding.

BEARING HOUSINGS (25) for B-2 with BEARING END COVERS (28) completely enclose the bearings protecting them against entrance of foreign matter.

BEARINGS FOR HYC. A duplex ball bearing to carry any unbalanced thrust and radial load is used on the outboard end. A babbitted sleeve bearing is used to carry radial load on the coupling end.

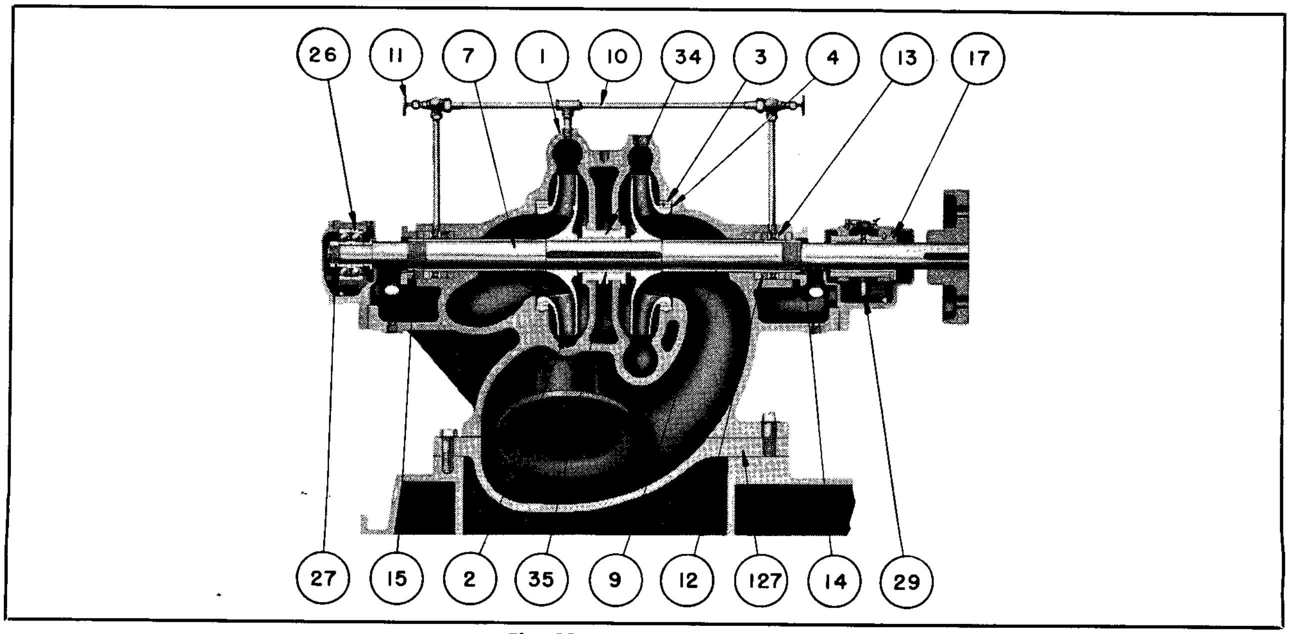

Fig. 23 — Type HYC Pump.

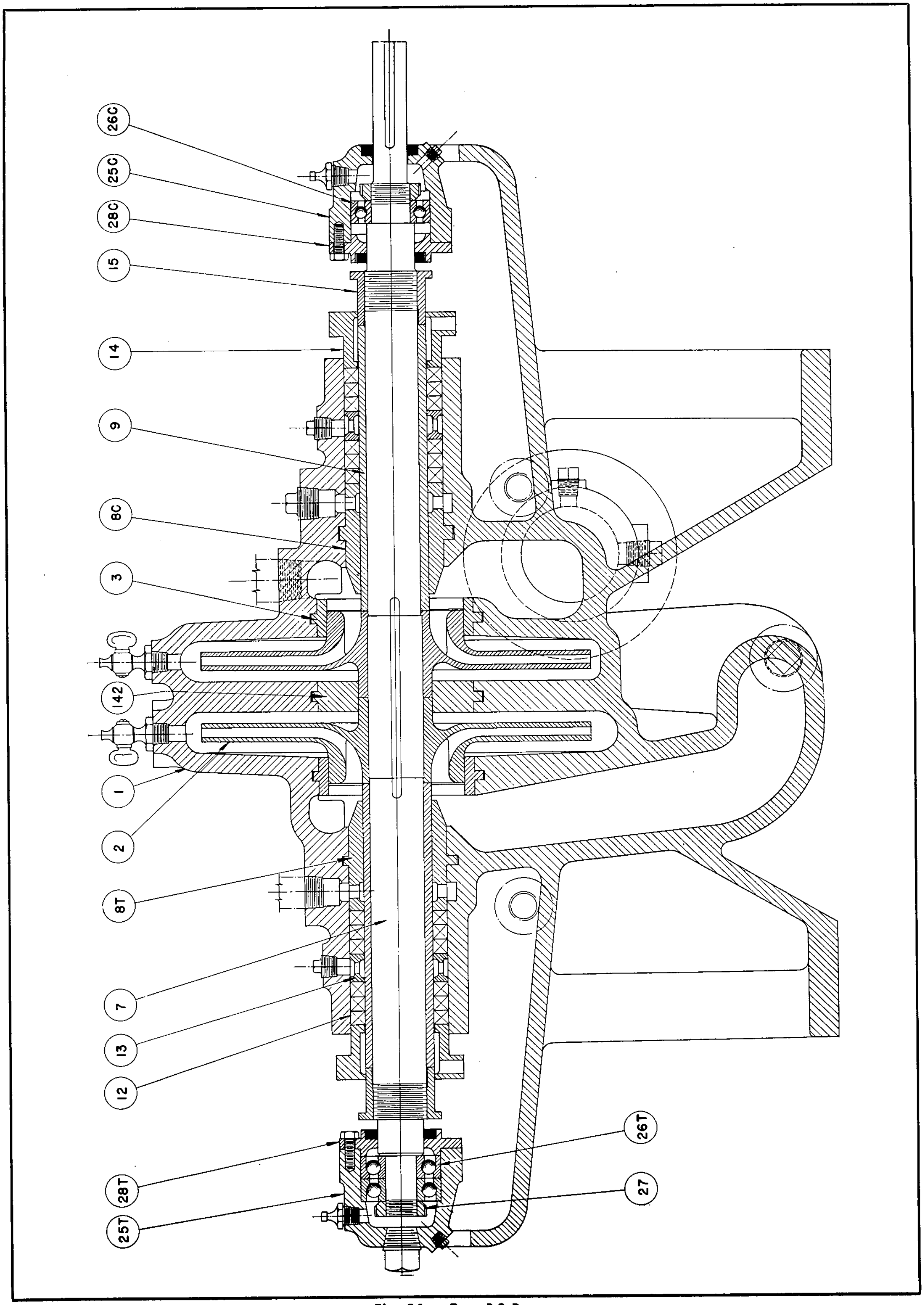

Fig. 24 — Type B-2 Pump.

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14. "Doubleton" Multi-Stage Pumps (Fig. 25)

CASING (1) The pump casing is horizontally split, with the suction and discharge nozzles in the lower half and with feet provided on the lower half casing located near to the horizontal centerline for supporting the pump on the base. The volute passages surrounding the impellers and the water passages extending from the volutes surrounding the impellers around to the succeeding inlets are cast integral in the two parts of upper and lower half casing. At the horizontal joint the casing is provided with very liberal flanges for bolting the two casing halves together. On the 6 and 7-stage pumps a removable end head is provided on the high pressure end which will allow for replacement of the stuffing box shaft sleeve without removing the upper half casing.

IMPELLERS (2). The impellers are of double action, enclosed type, accurately machined, ground and carefully balanced.

WEARING RINGS (3). Casing wearing rings are held in the casing surrounding the runner inlets. These wearing rings are held in the casing by a self-locking tongue and groove arrangement. Companion IMPELLER WEARING RINGS (4) are fastened to the impellers surrounding the impeller inlet openings and have a close running clearance with the casing wearing rings.

SHAFT (7). The shaft is annealed and machined and ground to exact size and perfectly true. It is of very liberal proportions, more than ample to transmit the maximum power required.

STUFFING BOXES. Water-cooled stuffing boxes are provided at each end of the casing arranged so that water can be introduced from an outside source into the jacket space surrounding the packing for the purpose of cooling the packing. Metallic packing is used in the stuffing boxes and the GLAND (14) is split type made of bronze.

PRESSURE REDUCING BUSHING (8). A long pressure reducing bushing is held in the casing end head between the last stage impeller and the stuffing box. This bushing provides a restricted passage between the bushing, and the stuffing box is relieved back to a lower pressure so that this arrangement reduces the pressure on the high pressure packing with a minimum leakage loss.

SHAFT SLEEVES (9). The shaft sleeves through the stuffing boxes and between the impellers are made of stainless steel, hardened.

BEARINGS. The bearings are of the split shell, babbitt lined, split type, held in cast iron housings bolted to the flanges on the ends of the casing. The outboard bearing is a combined radial bearing of the sleeve type and a thrust bearing of the pivoted shoe, Kingsbury type. The bearings are flood lubricated. An oil pump on the end of the pump shaft pumps oil through a cooler and to the sleeve and Kingsbury bearings.

Dismantling and Assembling Horizontal Split Casing Pumps

(Figs. 19, 20, 21, 22, 23, 24, 25)

A. REMOVING ROTATING ELEMENT

To remove the rotating element, the upper half casing should first be lifted by taking off the nuts, pulling the dowels, breaking the joint with the joint breaking bolts provided, then lifting the cover carefully to prevent damage to the rotating element.

After the bearing caps have been removed, lift the rotating element very carefully, taking care not to bend the shaft.

B. INSPECTION

After the pump has been dismantled, the following points should be watched in making an inspection:

1. The impellers should be inspected for breakage at vanes and hub, for worn, scored or broken impeller wearing rings, or for scale on the rings, or in the water passages.
2. Casing wearing rings should be inspected for scoring or wear, both inside and out. The clearance between the impeller and casing wearing rings will usually average about .002 inches on the diameter per inch of diameter, though this varies considerably with the size and type of pump, as well as with the service. Usually if the clearance has increased to about .030 inches on the diameter, the rings should be replaced.
3. The sleeves and interstage bushing should also be inspected for wear and scoring. The normal clearance of these parts will usually be the same as on the wearing rings.
4. The casing should be inspected for wear, or corrosion, especially at the fits around the wearing rings and bushings, and for evidence of leakage between stages, across these fits or along the main joint.
5. The shaft should be inspected for straightness. The shaft should be straight to within .003 inches.
6. The bearings should be inspected for wear. The Kingsbury shoes and thrust disc should be inspected to see that they are smooth and not unduly worn.

C. DISMANTLING ROTATING ELEMENT

The rotating element of a high pressure multi-stage pump requires very special handling, and involves the use of special tools; and it is recommended that, wherever possible, it be sent to the factory for dismantling and repair. However, when it is necessary to dismantle the rotating element in the field, the following points should be noted:

1. Pull coupling and remove thrust collar.
2. Back off shaft nuts. They have right or left hand threads arranged so that they will always tend to tighten with the rotation of the shaft. All parts should be carefully marked before removing from the shaft, to insure getting them back in the original position when the rotor is assembled.
3. Press off outer impellers and stuffing box sleeves. In most pumps handling hot water the impellers are shrunk on the shaft with about .002 inches press fit and a press is necessary to remove them.

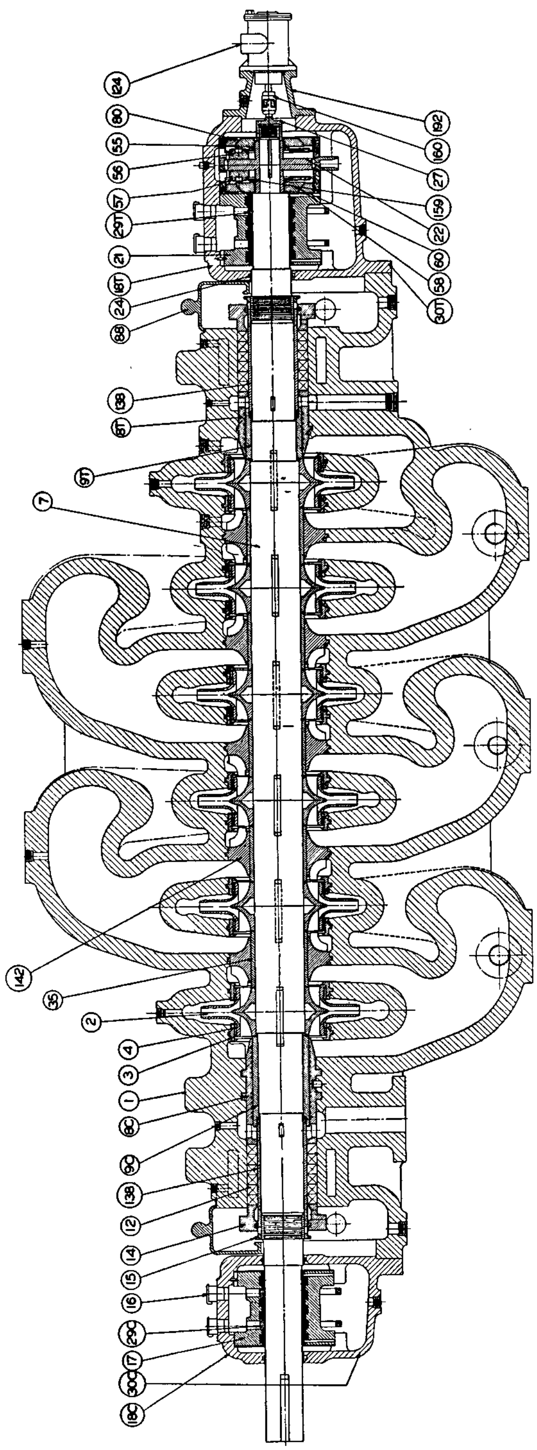

Fig. 25 — *Doubleton* Multi-Stage Pump.

CAUTION: *Heat can be used to facilitate the removal by carefully and uniformly heating the impeller to expand the hub, but care must be taken not to heat over 400 F. Some pumps are furnished with fabricated type impellers, and any great amount of unequal heat may cause the silver soldered joint to crack.*

4. Remove the keys for the outer impellers and press off the next two impellers and sleeves. Before removing last impeller measure its distance from the end of the shaft so that it can readily be assembled in the same place.

D. ASSEMBLING ROTATING ELEMENT

1. To replace impeller wearing rings, the old ones must be cut off with a chisel, and the old holding screws, if provided, cut off and peened over.

   New rings must be shrunk on by heating just enough to allow them to slip over the hub. They should not be heated over 600 F. If the impeller wearing rings are provided with holes for screws, the impeller should be drilled and tapped, and new screws put in and riveted over.
2. The shaft should be cleaned and checked for straightness to within .003 inches. All parts should be thoroughly cleaned, and the shaft coated with white lead.
3. The center sleeve with its bushing should now be installed and the keys fitted for the inner impellers. The impellers can then be shrunk in place, taking care not to heat them over 400 degrees F.
4. Note direction of rotation before installing the impeller and make sure that the bushings are installed in the proper direction. In *Doubleton* pumps, the bushings have baffles cast integral, and these baffles are arranged to be at the end of the suction passage. On stages where the suction comes in at the bottom, the baffles are in the upper half, and on stages where the suction comes in from the top they are in the lower half. In some designs the baffles have been welded into the casing.
5. Many pumps have different clearances on the suction and discharge end stuffing box bushings. When ordering these parts it should be specified whether they are for the suction or the discharge end of the pump, and when installing them they must, of course, be assembled on the proper end of the pump.
6. Before the shaft nuts are drawn up, the V-shaped groove between the shaft nut and the sleeve must be packed with linen boot cord, saturated with Glyptol lacquer and the nuts drawn tightly. This is to prevent leakage under the sleeve.

6a. On some pumps lead packing rings are used in place of boot cord for the purpose of preventing leakage under the shaft sleeves. When space is provided for this type of packing, we recommend a nearly solid lead ring similar to style 38AM manufactured by Felt Products Company of Chicago, Illinois.

7. Install oil rings and oil slingers if provided and then shrink the coupling in place. The thrust collar can then be installed as recommended in section on "Adjustment of Bearings."
8. The rotating element should then be checked for straightness and trueness at the coupling, bearing, stuffing box, wearing rings, and bushing fits. It should not run out more than plus or minus .003 inches at any point. If it is slightly out of true, it may be straightened with a bar without dismantling.

E. ASSEMBLING ROTATING ELEMENT IN PUMP

1. The casing must be perfectly clean at all of the bushing and wearing ring fits and at the main joints. The gasket should be cut, using the upper half casing as a template and must be a very good fit where it meets the wearing rings and bushings, and at the stuffing box. *NEVER HAMMER THE GASKET* at the wearing ring fit and bushing fit as this will destroy the sharp corners. These sharp corners form an effective seal at the joints and prevent internal leakage across the wearing ring or bushing fit. Gasket should be cut with a knife or scissors. The gasket material where used should be of the same thickness as originally furnished. In most cases this is 1/64 inch thick Johns-Manville service sheet.
2. After the rotating element is in place, it should be checked to see that it has end clearance in both directions. The total end clearance before the thrust bearing is set should be about ⅛ to ¼ inch. The rotor should be set centrally in this clearance, the thrust collar to have about .010 to .015 inch total clearance. The rotor should turn freely without rubbing before the cover is put on.
3. When the gasket is installed it should be pushed in to give a tight fit at all the machined fits and to be flush with the inside of the stuffing box. The gasket should be put on dry. Some gaskets are relieved around the bolts to give a higher initial gasket pressure.
4. The casing cover should be lowered carefully in place. The threads on the bolts and the nuts, and the faces of the nuts and washers should be painted with a lubricant as follows:

   ⅔ refined flake graphite
   ⅓ white lead thinned with penetrating oil
5. The casing dowels should be inserted and the casing nuts then drawn up by tightening gradually and evenly all around.
6. The pump should turn freely by hand after being assembled. The alignment should be checked.

SPECIAL INSTRUCTIONS FOR *DOUBLETON* PUMPS WITH END HEAD — (See Fig. 26)

CAUTION: *Pumps with end heads are not to be hydrostatically tested with head in place, since water jacketing is designed for suction pressure.*

Removing End Head

First remove the oil pump from the bearing body. Then remove the bearing cap. The bearing shells can now be removed by rotating on the shaft. Remove the cotter key in the thrust bearing retaining

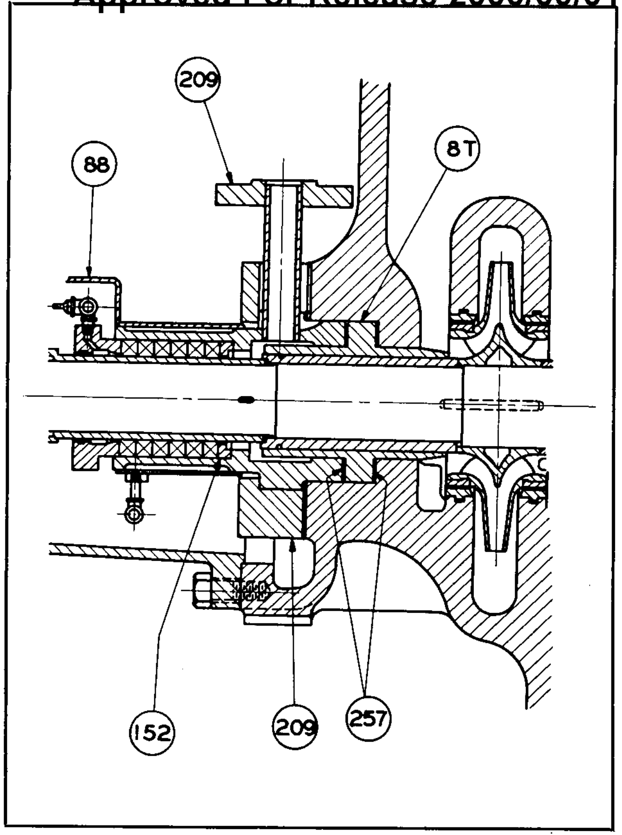

Fig. 26 — *Doubleton* Pump with End Head.

nut and remove the nut. Slip the bearing body endways together with the thrust bearing assembly and slide off of the shaft. The oil slinger will also have to slide along the shaft with the bearing body. The Kingsbury thrust bearing may be removed from the shaft as a unit. Next remove packing glands and packing. Remove the end head flange from the casing by removing the nuts and using the jack screw to break the joint. The stuffing box and bleed-off can then be removed.

Removing Discharge End Bushing and Shaft Sleeves

After the end head has been removed, the $\frac{1}{32}$ inch gasket between it and the bushing should be removed. The bushing has been drilled and tapped with two (2) ½-inch tapped holes. The special puller tools furnished with the pump include two (2) ½-inch studs and nuts together with a block plate. The block plate fits over the end of the shaft against a shoulder, while the two studs are screwed into the bushing and project through the block plate. The nuts can then be tightened against the block plate pulling the bushing.

The sleeve can be removed in a similar manner, except ¾-inch threaded rods are screwed into the solid recessed plate and the split plate with tongue is fitted in the groove at the end of the sleeve. The split plate is held together by the solid plate which acts as the puller plate. The block plate is used on the end of the shaft in same manner previously mentioned.

Special puller tools, furnished by manufacturer, should be used to remove the bushings and sleeves. The ½ inch tapped holes can be seen in the discharge stuffing box bushing after the $\frac{1}{32}$ inch gasket has been removed, which was placed between the bushing and the end head.

The shaft sleeve nut can be removed and the stuffing box packing sleeve can be pulled.

Assembly

After the casing cover has been set down the nuts should be tightened to give approximately 30,000 pounds per square inch tension to the bolts. We recommend the following practice in tightening nuts: All of the nuts should be tightened evenly with just enough force to assure that they are seated on the washer. A mark should then be placed at the corner of a Hex nut and project into the casing boss. A similar mark should be placed on the cap nuts and project on to their casing bosses. A pair of dividers should be open to the length of one flat of a Hex nut. All of the cap nuts and Hex nuts should now be tightened evenly to this amount. This is the equivalent of tightening the nuts one flat of a Hex. We have found by experience that this will give a uniform stretch of about .010 to .012 inches in the studs, which is equivalent to approximately 30,000 pounds per square inch tension.

The discharge end bushing can now be put in place, but care must be taken to see that the $\frac{1}{32}$-inch gaskets previously referred to are installed at both sides of the bushing. The nuts on flange of discharge and head should be tightened very slightly to insure that the head is seated against the gaskets. The space between the head and the casing then should be measured with a set of feelers and the gap closed up evenly by tightening the nuts.

The pump should turn freely by hand after being assembled. The alignment should be checked.

In packing a pump it is recommended that the packing be firmly packed into the box. The packing is cut with beveled ends and the alternate rings must be turned so that the joints are approximately 180 degrees apart. It is the best practice to press each individual ring in place with a dummy ring as it is being installed. This method assures the inner rings of packing doing their share of the work in preventing excessive leakage through the stuffing box.

The thrust bearing and remaining parts of the bearing bracket can then be assembled.

15. Barrel Type Multi-Stage Pumps (Fig. 27, 28)

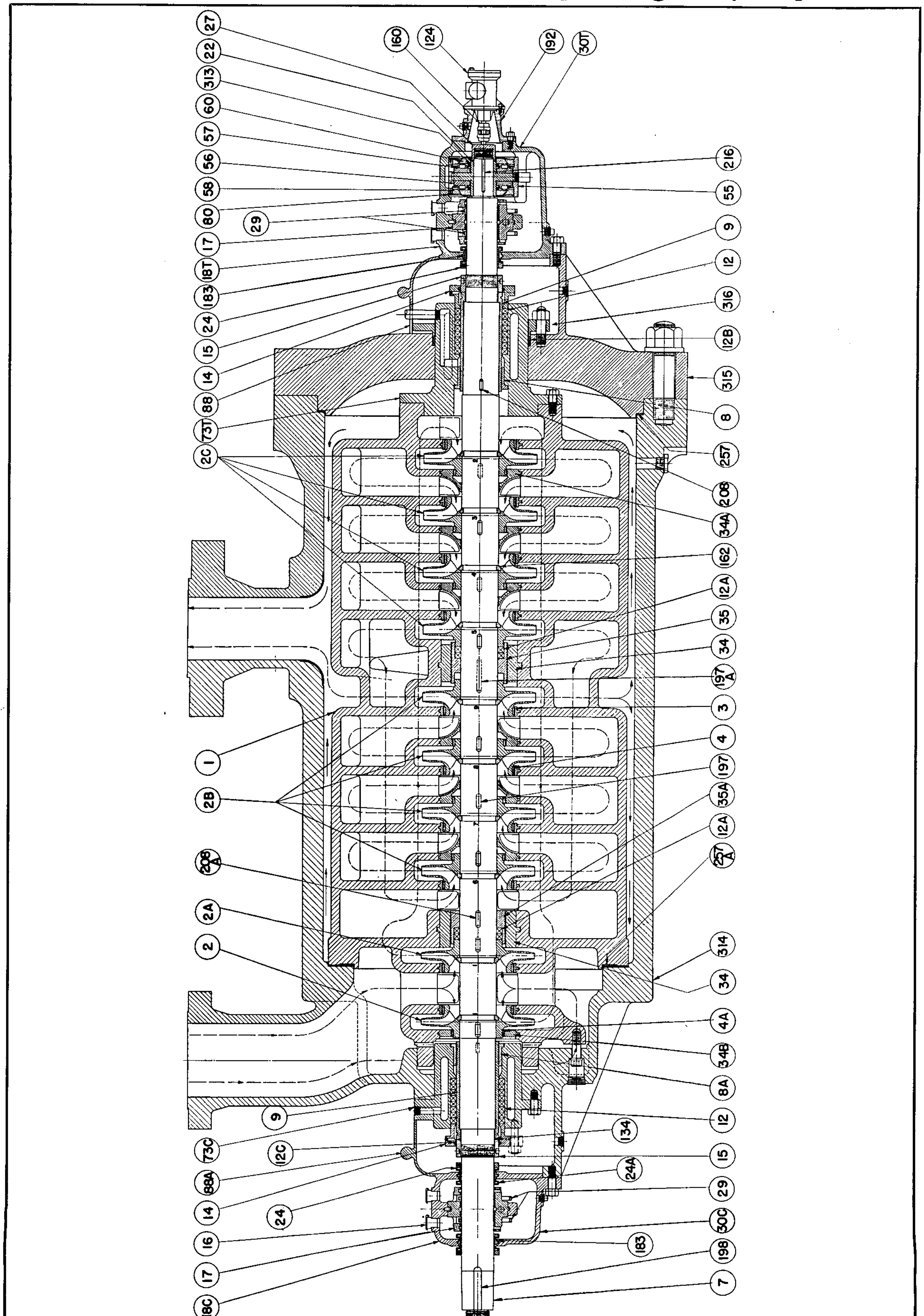

Fig. 27 — Barrel type pump with oil lubricated sleeve and Kingsbury type thrust bearings.

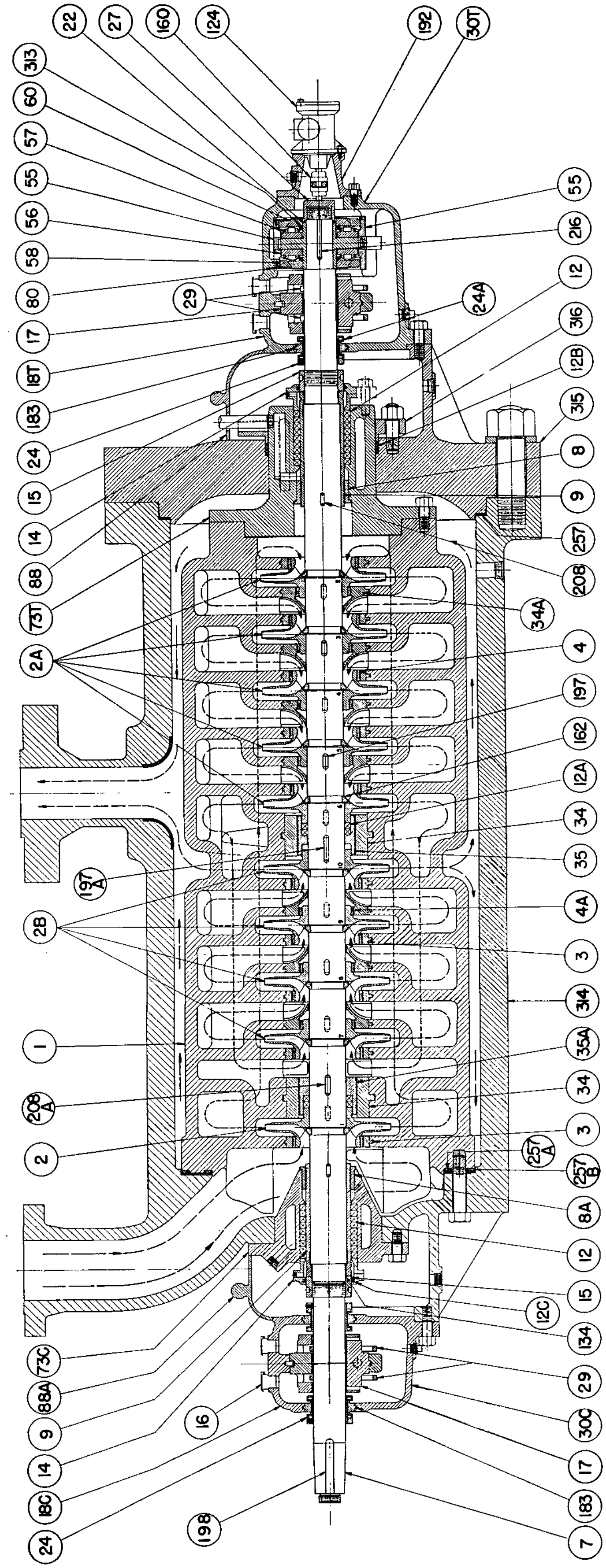

Fig. 28 — Barrel type pump without lubricated sleeve and Kingsbury type thrust bearings.

A. CONSTRUCTION

This type of pump consists of a relatively light weight split inner case pump inserted in a cylindrical heavy outer casing. The split casing discharges into the outer shell thereby subjecting the entire outer surface of the split case to discharge pressure. This serves to place the inner case under compression to maintain a positive pressure on the split faces thus insuring a tight joint.

OUTER CASING (314). This is a cylindrical barrel which during operation is under tension due to discharge pressure. A large substantial end head is bolted to the flanges of the barrel after insertion of the inner case. The barrel is supported at the horizontal centerline so that shaft alignment will be maintained during expansion due to temperature changes. The barrel is keyed to the base at the vertical centerline to maintain alignment when longitudinal expansion takes place.

INNER CASING (1) is split horizontally with upper and lower halves symmetrical to provide uniform expansion. The inner case is suspended at both ends on a comparatively small diameter. This permits radial expansion from the center to maintain accurate alignment of the rotor and bearings. The inner case is keyed to the outer case to prevent rotation. Double balanced volute passages are provided to eliminate radial thrust on the shaft. This results in smooth operation, uniform ring and bushing clearance, as well as increasing packing life because of elimination of shaft vibration.

The first stage is at one end and the second stage at the opposite end, so arranged that both glands will be under one stage pressure maximum. Arrangements can be made to connect to the suction or to a lower pressure point thus reducing the pressure on the packing.

IMPELLERS (2) are the single suction enclosed type accurately machined and balanced. Large capacity pumps have twin single suction half capacity impellers in the first stage arranged face to face so that leakage from other stages will enter first stage discharge instead of the suction, preventing any flashing at the impeller eye. The impellers are positioned by means of split rings which fit into machined recesses in the shaft and in the impeller hub. The impellers are individually mounted without spacer sleeves to allow free expansion or contraction. The unbalanced hydraulic thrust on each impeller keeps it snug against the split ring.

SHAFT (7) is made of stainless steel annealed, machined and ground to exact size and perfectly true. The shaft is of liberal proportions, more than ample to transmit the horsepower required.

WEARING RINGS (3) (4). Casing wearing rings are held in the casing with self-locking tongue and groove arrangement. Companion impeller wearing rings are fastened to the impellers surrounding the impeller inlet openings and have a close running clearance with the casing wearing rings. Where necessary there is also an impeller wearing ring on the back of the impeller which has a close running clearance with a casing wearing ring held in place with a self-locking tongue and groove arrangement.

STUFFING BOXES (73). Water-cooled stuffing boxes are provided at each end of the pump, arranged so that water from an outside source can be introduced into the jacket space to cool the packing. Metallic packing and split glands are used.

PRESSURE REDUCING BUSHING (8) is held in the casing between the second stage impeller and the stuffing box and between the first stage impeller and the stuffing box. This bushing provides a restricted passage along the shaft sleeve. At the end of the bushing a bleed point is located to relieve the pressure back to the suction or a lower pressure point. In this way packing pressures are reduced resulting in longer wear of the packing and less external leakage.

SHAFT SLEEVES (9) are provided through the stuffing boxes, pressure reducing bushings and high pressure bushings.

BEARINGS (17). Sleeve bearings are provided at both ends of the pump, arranged for ring oiling as well as pressure feed with cool oil from the oil pump and cooler. A Kingsbury thrust bearing with pivoted shoes is provided to take up any unbalanced thrust. Lubrication of the Kingsbury bearing is by pressure from the oil pump and cooler as well as viscosity pumping by the shoes.

B. DISMANTLING

The pump can be dismantled in the following order to the point desired: Remove OIL PUMP (124), OIL PUMP ADAPTER HOUSING (192), BEARING CAPS (18T), BEARING SHELLS (17), and OIL RINGS (29), retaining nut and oil pump coupling, pump half as a unit. LOWER HALF-HOUSING thrust end (30T), LOWER HALF BEARING HOUSING coupling end (30C), OIL SEAL (24, 24A, 183) on both coupling and thrust end. GLAND (14) on both ends, PACKING (12) on both ends, GLAND RING (316) on thrust end. STUFFING BOX suction end (73C) should be unbolted from suction end of barrel and remove by jacking screws. BARREL END HEAD (315) should be removed by the use of jacking screws. Flexitallic GASKET (257) should then be removed. Remove STUFFING BOX discharge end (73T) by the use of jacking screws. *THE PLUGS AND BOLTS RUNNING THROUGH THE SUCTION END OF THE BARREL INTO THE INNER CASING MUST THEN BE REMOVED.* Carriage should then be attached to the flange end of the barrel and the yolk should be attached with the extending legs to the carriage on the side away from the barrel. The two chain blocks should then be attached to the yolk and to two eye bolts which have been screwed into the tapped holes in the end of the inner casing. The step slides on the carriage should then be greased and checked for alignment with the slides on the inside of the barrel. By exerting equal pressure with the two chain blocks the casing can then be pulled out of the barrel. Dismantling of the inner casing and rotating element follow the reverse order of the assembly procedure.

CAUTION: *The impellers can most easily be removed by heating the back side of the impeller to expand the hub, but extreme care must be taken not to heat over 400 F. The impellers are of the fabricated type and any great amount of unequal heat may cause the silver soldered joint on the front side of the impeller to crack.*

C. ASSEMBLY OF ROTATING ELEMENT

1. SHAFT (7) should be carefully checked over and all burrs removed from impeller retaining ring grooves, key grooves and shoulders before proceeding. The keys should all be fitted in their respective keyways so that they are free and set in properly. The SHAFT NUTS (15) should both be tried on their respective threads to see that they turn on freely. *The nut on coupling end has left hand thread, and the nut on thrust end a right hand thread.*

2. Take all IMPELLERS (2) and remove all burrs and rough edges where they might interfere with the proper assembly on the shaft. The INTER-STAGE SLEEVES (35, 35A) should also be checked over carefully for burrs. The split impeller RETAINING COLLARS (162) should be cleaned up properly and checked for freedom of fit in the groove of the shaft. The impellers and interstage sleeves should be placed in a furnace or hot oil bath and heated thoroughly to between 350 and 400 F in preparation for the assembly on the shaft. DO NOT HEAT ABOVE 600 F. The first impeller to be assembled on the shaft should be the center impeller which faces the thrust end. Insert the SHORT KEY (197) in the shaft at the position of the center impeller. After the impeller has been thoroughly heated it can be slid over the shaft and lined up with the keyway as you approach the point. The impeller must be slid on past the retainer groove for this impeller. After the impeller has been slid past this groove the split impeller retaining rings can be inserted in groove around the shaft and the impeller pulled back until it drops and locks the retaining ring in place. The impeller is then in its proper position and should be held in position until cool. The work must progress smoothly and quickly after the heated impeller has been slid on the shaft.

3. The CASING RING (3) should now be slid over the shaft and placed as close to the impeller as possible. An INTERSTAGE BUSHING (34A) should be placed on the shaft with the small part of the bushing toward the suction of the impeller previously placed on the shaft. The casing ring and the interstage bushing should then be kept as far toward the impeller as possible and the next impeller should be slid over the shaft until it has passed the retainer ring groove and the split retainer ring put in place. The impeller can then be pulled back to lock the retaining ring in place. The same procedure is followed for the insertion of impellers for the remaining stages up to the thrust end of the shaft.

4. The next step is to slide the interstage shaft sleeve (the interstage sleeve is not the same on both ends and must be put on with the deep bore toward the center impeller), over the shaft from the coupling end until it gets close enough to the center impeller and yet allow room enough to install two rings of PACKING (12A) into the counter bore of the interstage sleeve. The interstage sleeve is then slid over the rear of the hub on the center impeller after impeller has cooled down. The interstage bushing which has been heated can now be slid over the interstage sleeve. The head will pass from the bushing to the sleeve so the sleeve will warm up sufficiently to pass over the next impeller. The last stage impeller can now be put on the shaft from the coupling end and pushed over the shaft past the impeller retaining groove by pushing the rear of the impeller hub underneath the interstage sleeve. This has to be done, however, while the interstage sleeve is still sufficiently hot to expand the bore and allow the impeller hubs to enter. The procedure for inserting the remainder of the impellers is the same as previous up to the point of installing the first stage impeller. Before putting on the first stage impeller the interstage bushing must be slid on the shaft and two rings of packing inserted into the bore of the sleeve. The heated interstage bushing can then be placed over the interstage sleeve and followed by the first stage impeller, after the sleeve has been heated sufficiently by the interstage bushing to pass over back of impeller hub.

5. The SHAFT SLEEVES (9) can now be slid on over the shaft and KEYWAYS (208), Permatex and BOOT CORD (134) should be inserted between the sleeve and the shaft. Then tighten the shaft nut until the face of the shaft nut and shaft sleeve butt very tightly and the boot cord is compressed sufficiently to seal any leakage underneath the shaft sleeve. The rotating element assembly has now been completed as far as possible before installing into the inner casing.

   Check rotating element for straightness which must be within .003 inches on the diameter.

D. PUMP ASSEMBLY

Before the rotating element is assembled into the casing, one of the casing rings on one of the end impellers should be removed and tried in each of the casing fits to make sure that the grooves are free of burrs and are of the proper size. This procedure cannot be followed for the interstage bushings. The rotating element can now be carefully set into the LOWER HALF CASING (1) with the coupling end of the shaft coming out of the large end of the inner casing.

The horizontal joint of the inner casing is metal to metal. The joint has been carefully lapped and should be protected. Before setting the upper and lower halves together, each joint face should be coated with a thin coating of Kopaltite. The compound should be placed in a strip about one inch wide just inside the bolt holes, and another strip about one-half inch wide extended inward on each ring fit wall. The Kopaltite must be spread very thin to prevent excess from extruding into the ring fit grooves.

The UPPER HALF INNER CASING (1) can then be placed over the rotating element and lower half casing, extreme care being taken against damaging the lapped surface of the casing joint since no gasket is used between the upper and lower half casing. The two halves of the casing can then be bolted together and the bolts tightened securely with no intent to stretch the bolt. The assembly of STUFFING BOX DISCHARGE END (73T) and CASING BUSHING (8) also 1/64″ gasket, can now be slid over the shaft with the large female fit toward the pump casing. This assembly should be slid over the thrust end of the shaft and bolted onto the inner casing. With the pipe tap connection being on the upper side for the 5 x 5″ and 8 x 8″, and on the bottom for the 6 x 6″ on the vertical centerline of the pump.

The FLEXITALLIC GASKETS (257A, 257B) should now be placed on the coupling end of the inner pump casing. The inner casing is now ready for assembly into the PUMP BARREL (314).

The assembly carriage furnished with pump should now be attached to the lower half of the flanged end of the barrel and secured by two nuts on the studs on the horizontal centerline corresponding to the point on the carriage where the bosses are placed on the flange. After this assembly is made the step slides of the carriage should be checked for alignment with the step slides in the barrel to assure the free movement of the inner casing into the barrel. The assembled inner casing should be then placed into the carriage with the Flexitallic gasket facing toward the barrel. The yolk should then be assembled to the stuffing box by bolting the closed end to it with bolts inserted in two top jack screw tapped holes. Chain blocks should then be attached between the carriage ears and the corresponding ears projecting from the legs of the yolk. By applying force on the chain blocks equally the inner casing can now be slid into the barrel until the Flexitallic gaskets come against the machined surface at the other end of the barrel. The carriage and yolk should now be removed from the barrel and the flange face and counterbore cleaned thoroughly. The bolts on the suction end of pump can now be put in and the inner casing pulled firmly up against the Flexitallic gasket. After these bolts have been tightened the plugs should be inserted to seal the heads. The Flexitallic gasket should now be placed on the BARREL END HEAD (315). The barrel end head should now be slid over the stuffing box. In order to slide the barrel end head into the counterbore of the barrel flange it will be necessary to lift the barrel end head slightly, at the same time lifting the inner casing in order to make the entry into the counterbore. This can most easily be done by removing the drain plug on the bottom of barrel and inserting the tapped-out plug and jack bolt in its place. The nuts and washers should then be placed on the studs and the end head pulled up uniformly until the barrel flange and the barrel end head flange make metal to metal contact. The bolt should then be stretched by sledging nut or heating bolt to get an additional ¾ of a turn.

The STUFFING BOX ASSEMBLY SUCTION END (73C) together with casing bushing low pressure, should now be slid over the shaft and shaft sleeve on the coupling end or suction end of the barrel and then slid into the bore of the barrel on the suction end. The fit into the barrel should be snug but should slide in without undue pressure. A 1/64″ service sheet gasket should be installed between the stuffing box flange and the casing. The bolts which go through the suction end of the barrel into the inner casing should now be inserted and pulled up securely. The plugs which cover these bolts should now be installed and pulled tight.

The bearing oil seals can now be installed on the shaft, one on the thrust end and two on the coupling end. The one on the thrust end of the shaft will be assembled by first putting the DEFLECTOR (24) over the shaft with the set screw loose. The BEARING SEAL RING (183) can then be slid on the shaft followed by the DEFLECTOR SLEEVE (24A) which slides on through the bore of the bearing seal ring and deflector. The set screw and deflector can be left loose until the proper location is obtained when making the assembly into the bearing bracket. The same procedure would be followed for the assembly of the oil seal on the pump side of the coupling end set, and the procedure of installation of parts reversed for the installation of the oil seal on the outboard side of the coupling end set.

The PACKING (12B) should then be installed in the end head followed by GLAND RING (316) and then pulled up securely to prevent leakage from the inside of the barrel past the stuffing box housing.

The Kingsbury bearing assembly should now be fitted over the SHAFT AND KEY (216) being sure that the direction arrow corresponds to the rotation of the pump. The Kingsbury bearing can then be locked on the shaft with RETAINING NUT (27) held in place after securely tightening by drilling a hole through the nut and shaft and inserting a split cotter key. The COUPLING END and THRUST END LOWER HALF BEARING HOUSING (30C) and (30T) respectively, can now be bolted to the bearing bracket of the barrel and barrel end head respectively. The BEARING SHELL (17) initially had .004″ — .006″ diametrical clearance. This dimension should be checked and the bearing replaced when the clearance has increased to .008″ — .010″. The bearing shell should then be installed in the bearing housing together with OIL RINGS (29) and then the BEARING CAPS (18C and 18T) can be installed and bolted securely. The alignment of the bearing housings can be accomplished by locating the shaft concentrically in the stuffing box on each end of the barrel. The Kingsbury bearing should then be adjusted by backing off both Kingsbury bearing ADJUSTING RINGS (58) and determine the total endways movement of the rotating element in the pump. The shaft should then be located at the center of this end play and the Kingsbury bearing adjusting rings, turned in until tight. The outboard adjusting ring should then be loosened two notches which gives an approximate .010″ — .012″ clearance in the Kingsbury bearing. The oil pump coupling should now be attached to the shaft extension of the pump and to the OIL PUMP SHAFT (124). A 1/64″ oiled paper gasket should be inserted between bearing bracket and oil pump adapter. The OIL PUMP ADAPTER HOUSING (192) can then be bolted on the BEARING HOUSING (30T) and BEARING CAP thrust end, (18T) having the pipe plug on the top side. The OIL PUMP (124) with COUPLING (160) can then be bolted on to the adapter housing and adjustments should be made for 1/32″ to 1/16″ clearance between the ends of halves of oil pump coupling.

The pump can now be packed with packing and pulled into place with GLAND (14).

16. Type C 2-Stage Condensate Pumps (Fig. 29)

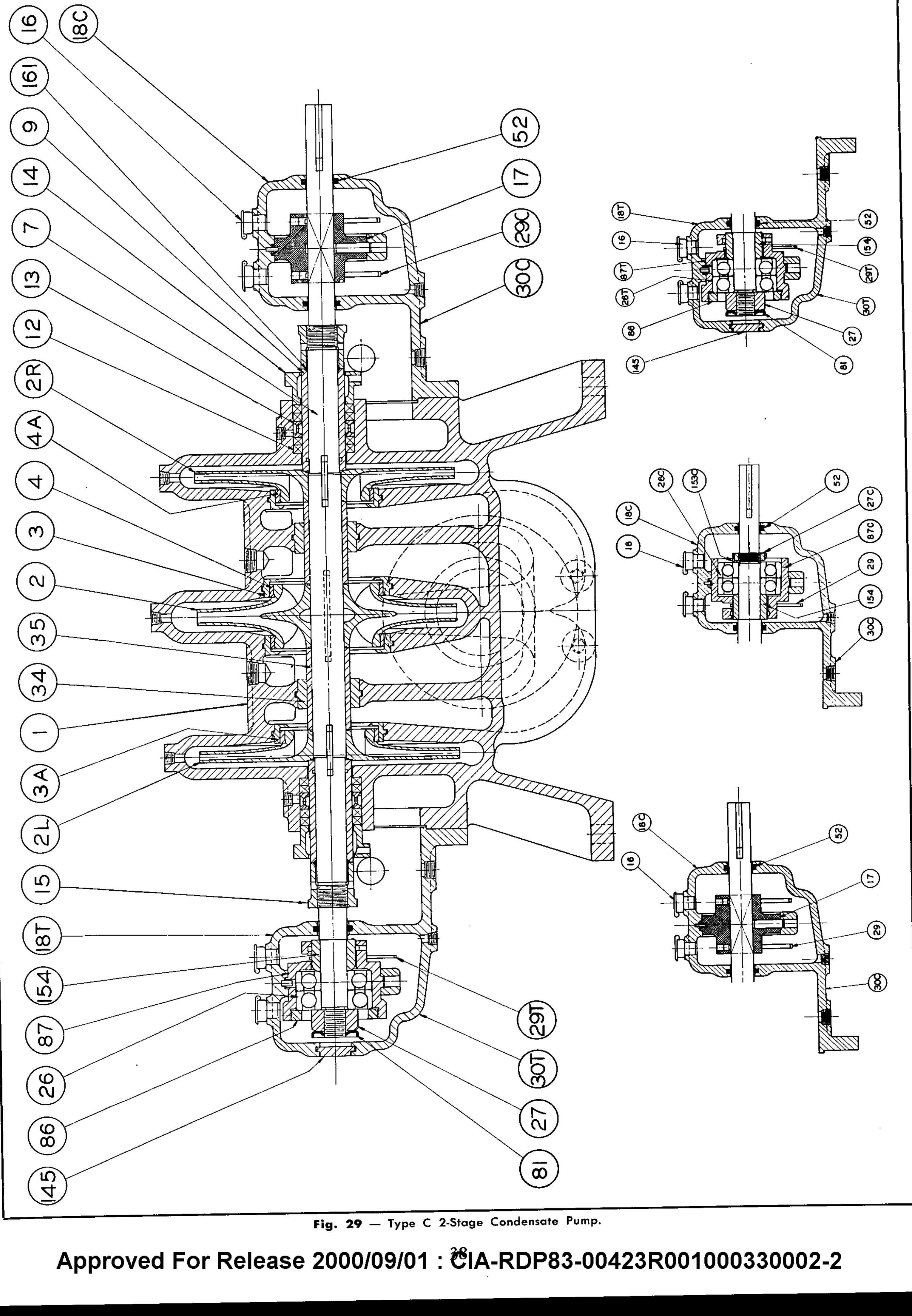

Fig. 29 — Type C 2-Stage Condensate Pump.

The removal of condensate from the condenser hotwell imposes severe operating conditions on the condensate pump. It must operate with a high lift on the suction due to the vacuum in the condenser, handle a liquid near its boiling point with a positive sealing head reduced to a minimum and operate over a wide range in capacities as a result of load changes on the prime mover which it serves. The operation of the entire plant is dependent on its constant removal of the condensate coming into the hotwell.

The Allis-Chalmers two-stage condensate pump combines all the essential features required in condensate removal with the rugged construction of the standard line of Allis-Chalmers pumps. Through the placing of the double suction first stage impeller between the two single suction second stage impellers, hydraulic balance is maintained over all conditions of load. To take care of a possibility of unbalance due to the passages becoming obstructed and to permit the pump to operate without damage under this condition, a ball type thrust bearing is provided on the outboard end. An air cooled Kingsbury type thrust bearing can be supplied for all pumps except the 4 x 2 C2H.

Positive pressure from the discharge of the second stage impellers effectively seals the glands against leakage of air into the vacuum system.

Large vents are provided in the suction chamber of the pump to permit quick removal of any vapor which may be liberated.

17. Type CF2V (Fig. 30) and CF2VT (Fig. 31) Centrifugal

The type CF2V centrifugal pump is mounted on a pedestal and supported from the floor. The pump is of the two stage vertical shaft type with the casing split along the axis of the shaft. The first stage impeller is of the single or double suction type and located at the lower end of the pump so as to obtain maximum available sealing head. The second stage impeller is the single suction type.

The stuffing box is under positive pressure from the second stage impeller.

The type CF2VT centrifugal pump is mounted in a hotwell tank and supported from the coverplate. The pump is of the two stage vertical shaft type with the casing split along the axle of the shaft. The first stage impeller is of the single or double suction type and located at the lower end of the pump to obtain maximum available sealing head. Second stage impeller is single suction type.

The stuffing box is mounted in the hotwell tank and subject to pump discharge pressure.

A. ROTATION

The direction of the rotation is clockwise when looking at the pump from the driven end.

B. CONSTRUCTION

CASING (1) is made of close grained cast iron split along the shaft axis for easy removal of the rotating element. A rigid coupling is provided above the upper bearing of the pump for coupling to the motor.

IMPELLERS (2) are made of bronze of the single or double suction enclosed type. The impellers are mounted on the shaft so as to be opposed and to obtain hydraulic balance.

WEARING RINGS (3 and 4). Bronze companion wearing rings are furnished which are securely locked in the casing and on the impellers. They are easily renewable so as to allow replacement when worn.

SHAFT (7) is made of steel, accurately machined, ground and of ample size to transmit the maximum power required.

SHAFT SLEEVES (9). The interstage shaft sleeves and the shaft nuts are made from bronze castings. The lower and upper shaft sleeves are made of stainless steel.

STUFFING BOX. A stuffing box is provided where the shaft passes through the casing and is packed with soft asbestos packing. A bronze split seal cage is provided for packing lubrication.

BEARINGS. Water lubricated hard carbon sleeve bearings are provided at the top and bottom of the pump to carry radial loads. The weight of the rotor and any temporary hydraulic unbalance is carried by the motor thrust bearing.

MOTOR MOUNTING. A pedestal is bolted to the top of the pump casing for mounting the driving motor.

C. DISMANTLING AND ASSEMBLY

1. Type CF2VT (Fig. 31)

1. Remove motor. NOTE: Keep shims in order so they may be replaced properly when reassembling unit.
2. Remove tank cover and pump.
   a. Remove tank flange bolts and break joint with jacking bolts provided.
   b. Remove sealing water and discharge pipes.
   c. The pump assembly and cover plate can be removed as a unit.
3. Dismantling pump.
   a. Dismantle pump coupling, remove pump support bolts and discharge piping bolts to free pump.
   b. Remove casing end cover.
   c. Pump may then be dismantled and assembled as a horizontal split casing multi-stage pump. (See Page 29 for further instructions.)

2. Type CF2V (Fig. 30)

a. To Remove Casing Cover and Examine Impeller

Remove casing nuts. Take out dowels. Remove cap screws in casing end cover. The removable half casing may now be lifted off.

b. To Remove Rotating Element

Remove casing cover as above. Remove coupling bolts. Slide covers back exposing gridmember. Remove the gridmember by prying from slots with a screw driver. Take out tap bolts. The rotating element may now be lifted out.

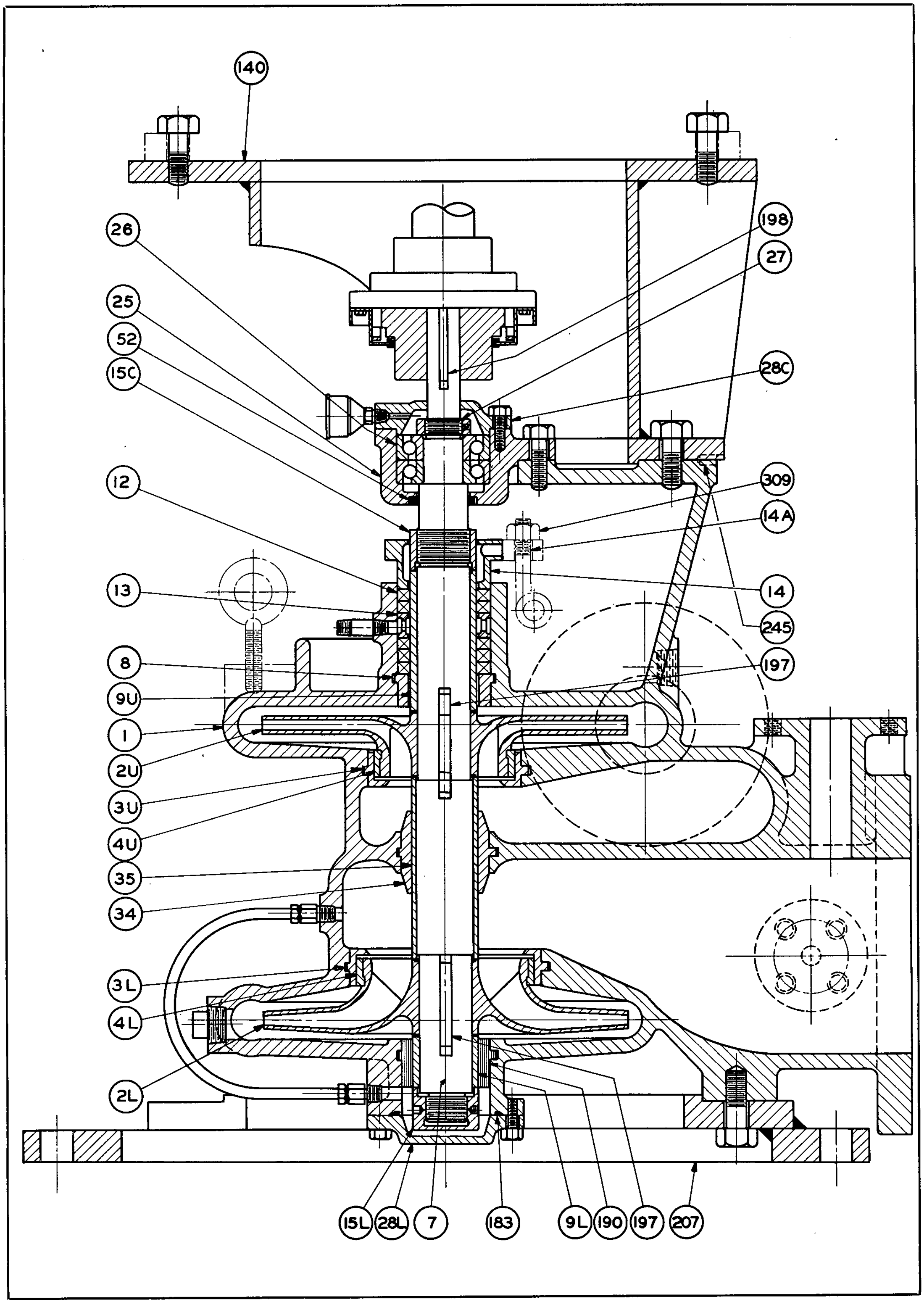

Fig. 30 — Type CF2V Pump.

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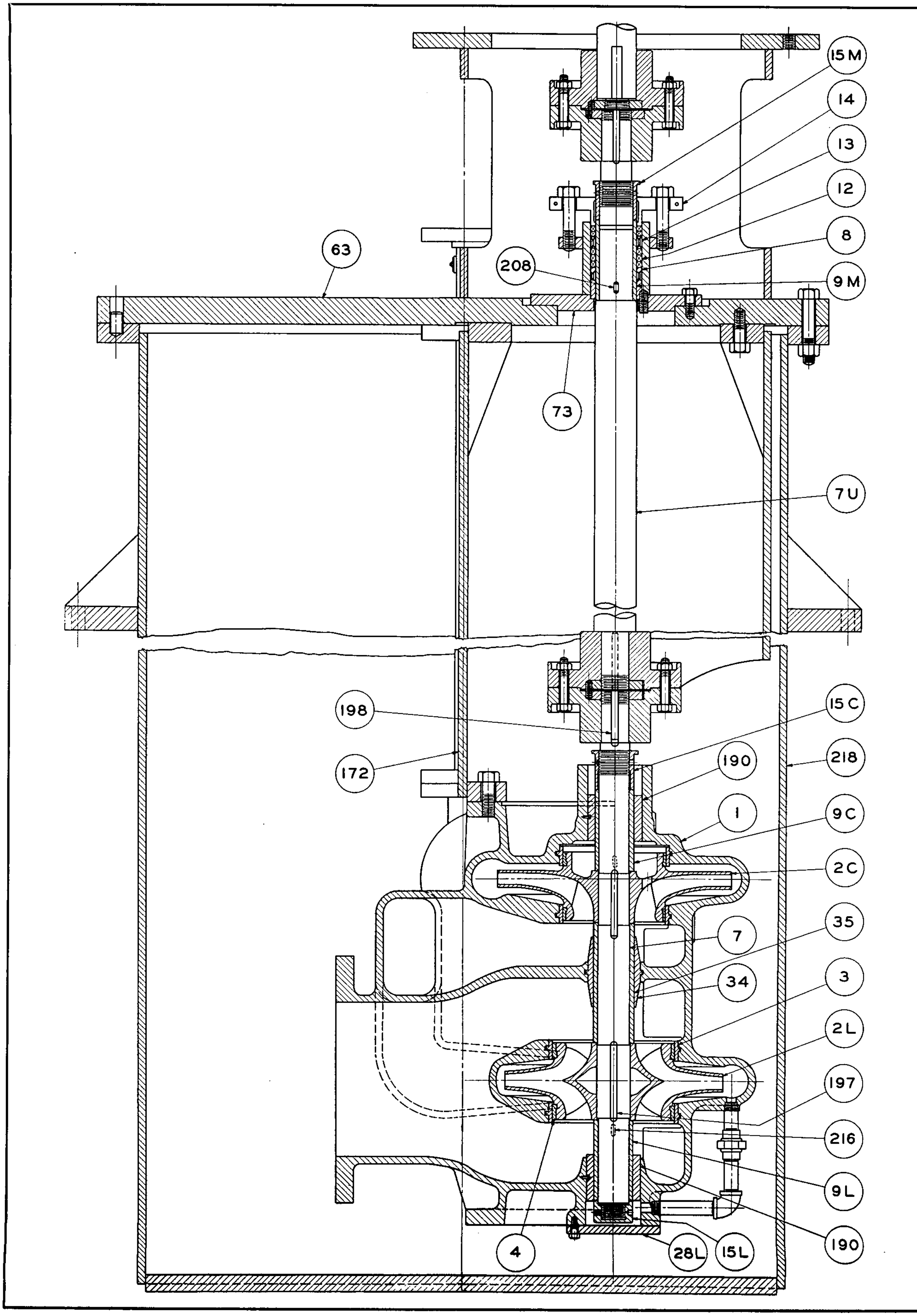

Fig. 31 — Type CF2VT Pump.

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c. To Remove Upper Bearing

Remove rotating element as explained above. Pull pump half coupling from shaft using pulling tool. Remove cap screws in bearing body cap and remove the bearing body cap from shaft. Loosen set screw in bearing retaining nut and remove nut using spanner wrench. The duplex bearing should be pulled off using the same pulling tool as used for the coupling. Place puller in back of bearing body and pull the bearing body and duplex bearing from end of shaft.

d. To Remove Lower Water Lubricated Bearing

Remove the rotating element as explained above and the lower water lubricated bearing will slide from end of shaft.

e. To Remove First Stage (Lower) Impeller

Remove rotating element and lower bearing. Loosen locking set screw and turn off suction shaft nut using spanner wrench. Place pulling tool in back of impeller and pull impeller and lower shaft sleeve from end of shaft.

f. To Remove Second Stage (Upper) Impeller

Remove upper bearing as explained above and turn off (L.H.) discharge shaft nut using spanner wrench. Use pulling tool to pull impeller and packing sleeve from shaft.

g. To Remove Wearing Rings

The casing wearing rings can be removed after either of the impellers have been removed. The impeller wearing rings may be removed by cutting in two with a cold chisel. The impeller should be supported so that the inlet of the impeller is not damaged by pounding.

h. To Assemble Rotating Element

Place interstage shaft sleeve and interstage bushing in position on shaft. Put casing wearing ring on shaft and then press on impeller to approximate position. Place lower shaft sleeve on shaft and turn shaft nut only finger tight. Place casing wearing ring over shaft and press on impeller until it touches shaft sleeve. Place upper shaft sleeve in position and turn on shaft nut. (Do not tighten.) Slide stuffing box bushing onto packing sleeve. Assemble upper bearing to shaft and place rotating element in position in pump. Check to see that the impellers are centered in the volutes. If they are not centered adjust shaft nuts until they are centered properly. When the impellers are in the proper position on the shaft, tighten both shaft nuts and the set screw in the lower nut. Press on coupling and the rotating element is ready for assembling in the pump.

i. To Assemble Rotating Element In Pump

Place the rotating element in position being particularly careful that the lower bearing, casing wearing rings, interstage bushing and stuffing box bushing are placed properly. (The long tongue fits into the fixed half casing.) Put in tap bolts holding bearing body to casing, tap dowels in place and tighten the tap bolts. Place the removable half casing in place being sure that the gasket is not damaged and that it fits properly at the wearing rings and bushings. Turn on nuts and tighten. Replace casing end cover. Assemble coupling, replace packing, staggering the joints and put in three rings before putting the waterseal ring in place. The waterseal ring should be placed with holes in the end up to facilitate removing. Replace the gland but tighten only finger tight. The rotating element should move freely when turned by hand.

18. Type CB2VT Centrifugal Condensate Pumps

The CB2VT type centrifugal pump is mounted in a hotwell tank and supported from the cover plate. The pump is of the two stage vertical shaft type with the casing arranged for removing the rotating element through a top cover of the pump. The first stage impeller is of the single suction type and located at the lower end of the pump so as to obtain maximum available sealing head. The stuffing box is under positive water pressure from the second stage impeller.

A. ROTATION

The direction of rotation is clockwise when looking at the pump from the driven end.

B. CONSTRUCTION

CASING is of close grained cast iron with a cover plate arranged for removal of the rotating element from the top. The cover plate has a heavy flange which is fitted to the casing to insure accurate alignment and is bolted securely. A bracket is bolted to the cover plate which supports the pump. A suction bell is cast integral with lower half casing as well as a discharge nozzle, which is flanged for connection to the discharge pipe.

IMPELLERS are made of bronze, and are of the single suction enclosed type. The impellers are mounted on the shaft so as to be opposed and to obtain complete hydraulic balance.

WEARING RINGS. Bronze companion wearing rings are furnished which are securely locked in the casing and on the impellers. They are easily renewable so as to allow replacement when worn.

SHAFT is made of steel, accurately machined, ground and of ample size to transmit the maximum power required.

SHAFT SLEEVES. The upper shaft sleeve and the shaft nuts are made from bronze castings. The lower shaft sleeve is stainless steel.

STUFFING BOX is provided where the shaft passes through the tank cover and is packed with soft asbestos packing. A bronze split seal cage is provided for packing lubrication.

BEARINGS. A grease lubricated ball bearing is provided at the top of the shaft to carry the weight of the pump rotor as well as any unbalanced thrust. Water lubricated laminated phenolic bearings are provided just above the second stage impeller and between the two impellers to carry radial load.

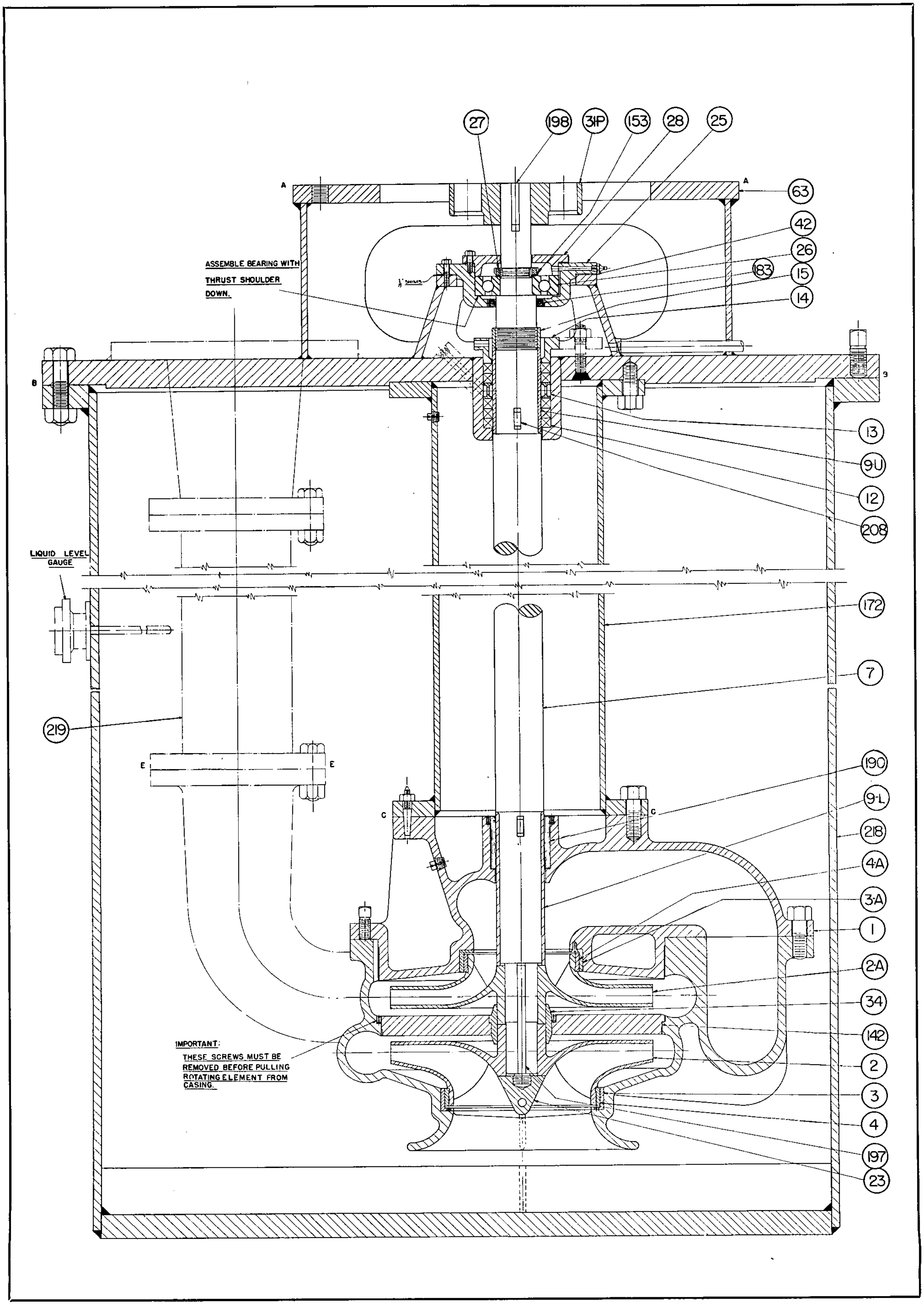

Fig. 32 — Type CB2VT Pump.

C. DISMANTLING PROCEDURE

A. Removal of drive:
1. Remove flange bolts at joint AA.
2. Remove coupling bolts. Back the nuts partly off of the coupling bolts. Then drive the coupling bolts out by striking the end of the nuts, or remove the nuts and drive the coupling bolts out with a piece of soft metal.
3. Remove drive.

B. Removal of tank cover and pump:
1. Remove flange bolts at joint BB, and break joint with jacking bolts provided.
2. The entire tank cover with pump attached can now be lifted out of the tank.

C. Removal of shaft:
1. Pump half coupling. Use a coupling puller and pull the coupling from the shaft.
2. Ball bearing end cover.
3. Retaining nut and lock washer.
4. Ball bearings and ball bearing housing. (Use short jacking bolts, which can be inserted through stuffing box access opening to remove these two items.)
5. Bearing end seal. This will come off with the two previous items.

D. Removal of cover from shaft:
1. Remove flange bolts and dowels and break joints CC and EE.
2. Remove hotwell cover plate from shaft.

E. Removal of impellers from shaft:
1. Remove bolts, break joint DD and slide upper half casing back along shaft.
2. Remove set screws holding interstage diaphragm in place.
3. Remove interstage diaphragm from the lower half casing by pushing upward with the top surface of the lower impeller.
4. Remove rotating element from the lower half casing.
5. Remove set screw from impeller nut and then take off impeller nut.
6. Remove first stage impeller.
7. Remove interstage diaphragm.
8. Remove second stage impeller.
9. The remaining parts can now be dismantled.

D. ASSEMBLING PROCEDURE

A. Assemble on shaft.
1. On impeller end.
   a. Shaft sleeve
   b. Second stage impeller
   c. Interstage diaphragm and bushing. Be sure that set screws which fasten bushing in diaphragm are in place.
   d. First stage impeller
   e. Impeller nut. Be sure to lock with set screws.
2. On coupling end.
   a. Shaft sleeve
   b. Shaft nut

B. Slip upper half casing with casing rings already inserted, over shaft from coupling end, keeping well back from impellers.

C. Put sleeve bearing in place and lock with set screws. Check clearance.

D. Slip lower half casing with first stage casing ring already inserted, over the first stage impeller and then set the interstage diaphragm in the lower half casing. Press diaphragm into casing by tapping around outer edge. Insert set screws and tighten by inserting screw driver in slot provided in lower half casing.

E. Bolt the upper half casing to the lower half (joint DD) being sure that the jack screws are turned back.

F. Bolt the upper end of the shaft tube to the cover plate and the lower end to the casing (joint CC). Set the dowels before tightening the latter bolts. Flanged pipe should also be bolted in place, the upper end to the cover plate and the lower end to the casing (joint EE).

G. Put ball bearing housing and bearing seal ring over the shaft.

H. Press ball bearing over the shaft being sure that it seats squarely on the shoulder of the shaft.

I. Tighten and lock bearing nut and washer.

J. Put bearing end cover over shaft and bolt to the bearing housing.

K. Bolt the bearing housing to the hotwell cover with the proper amount of shims between them to have the impellers centered in the volutes and having end clearances between the lower face of the impeller and casing ring.

L. Carefully shrink pump half coupling and motor half coupling on the respective shafts by heating to about 400 degrees F.

M. Put assembly of hotwell cover and pump into the tank. Bolt cover to the tank (joint BB) being careful to have jack bolts turned back.

N. Check to see that the shaft rotates freely before proceeding.

O. Packing stuffing box, being careful to have seal cage across the opening of the sealing water supply.

P. Mount the drive on the pedestal.

Q. Check alignment of coupling halves and insert pins with brass lined rubber bushings.

How to Locate Trouble

No Water Delivered

CAUSES	CURES
1. Lack of prime.	Fill pump and suction pipe *completely* with water.
2. Speed too low.	Check whether motor is directly across-the-line and receiving full voltage. Or frequency may be too low, motor may have an open phase. If turbine drive, check governor setting and throttle valve.
3. Discharge head too high.	Check pipe friction losses. Larger piping may correct condition. Are valves *wide* open?
4. Suction lift too high.	If no obstruction at inlet, check for pipe friction losses. However, *static* lift may be too great. Measure with mercury column or vacuum gauge while pump operates. If static lift is too high, water to be pumped must be raised or pump lowered.
5. Impeller completely plugged.	Remove top of pump casing and clean impeller.
6. Wrong direction of rotation.	This sometimes occurs! Compare turning of motor with directional arrow on pump casing.
Not Enough Water Delivered	
7. Air leaks in suction piping.	If liquid pumped is water or other non-explosive — and explosive gas or dust are not present — you can test flanges for leakage with flame or match. For such liquids as gasoline, suction line can be tested by shutting off or plugging inlet and putting line under pressure. A gauge will indicate a leak with a drop of pressure. Seal leaks.
8. Air leaks in stuffing box.	Check to see if thin stream of water flows from stuffing box while pump operates. If not — and adjusting gland to reasonable extent does not produce flow — new packing probably is needed. Or — water seal piping may be plugged and need cleaning out . . . seal cage may be plugged or displaced and need centering at water seal piping. Or — shaft sleeve beneath packing may be so badly worn that air works into pump. Replace sleeve.
9. Speed too low.	See item 2, above.
10. Discharge head too high.	See item 3, above.
11. Suction lift too high.	See item 4, above.
12. Impeller *partially* plugged.	See item 5, above.
13. Not enough positive suction head for hot water or volatile liquids. (Can be determined with gauge. If water is flashing into steam, gauge jumps all over.)	Hot water can't be lifted very high — and extremely hot water can't be lifted at all. In many cases, the pump must be considerably *lower* than the source of hot water . . . so water will flow in under pressure. Pressure required depends on temperature of water, pump capacity, and type impeller used. Safest solution is to consult with pump manufacturer.
14. Defective wearing rings.	Inspect. Replace if worn excessively.
15. Defective impeller.	Inspect. Replace if damaged or vane sections badly eroded.
16. Defective packing.	Replace packing . . . and sleeves, if badly worn.
17. Foot valve too small or partially obstructed.	Inspect. Area through ports of valve should be at least as large as area of suction pipe — preferably 1½ times. If strainer is used, net clear area should be 3 to 4 times area of suction pipe.
18. Suction inlet not immersed deep enough.	If inlet can't be lowered — or if swirling eddies through which air is sucked persist when it is lowered — chain a board to suction pipe. It will be drawn into eddies, smothering the vortex.
19. Wrong direction of rotation.	Symptoms are an overloaded drive and about ⅓ rated capacity from pump. Compare rotation of motor with directional arrow on pump casing.
Not Enough Pressure	
20. Speed too low.	See item 2, above.
21. Air or gases in liquid — e.g. marsh gas in swamp water. (Test in laboratory, reducing pressure on liquid to pressure in suction line. Watch for bubble formation.)	May be possible to overrate pump to point where it will provide adequate pressure despite condition. Better to provide gas separation chamber on suction line near pump, and periodically exhaust accumulated gas.
22. Mechanical Defects.	See items 14, 15, 16, above.
23. Obstruction in water passages.	Remove casing cover and inspect passages of impeller and casing. Remove obstruction.
24. Too small impeller diameter (probable cause, if none of above).	Check with your pump manufacturer to see if a larger impeller can be used. Otherwise, cut pipe losses, or increase speed . . . or both, as needed. *But be careful that you don't seriously overload your drive.*
Pump Works for a While and Quits	
25. Incomplete priming.	Free pump, piping and valves of *all* air. If high points in suction line prevent this, they need correcting. See Suction Piping.
26. Suction lift too high.	See item 4, above.
27. Air leaks in suction piping.	See item 7, above.
28. Air leaks in stuffing box.	See item 8, above.
29. Air or gases in liquid.	See item 21, above.

Pump Takes too Much Power	
CAUSES	**CURES**
30. Head lower than rating, pumps too much water.	Turn down impeller's outside diameter to size advised by pump manufacturer.
31. Liquid heavier (in either viscosity or specific gravity) than allowed for.	Use larger driver. Consult pump manufacturer for recommended size. Test liquid for viscosity and specific gravity.
32. Wrong direction of rotation.	See item 19 above.
33. Stuffing boxes too tight.	Release gland pressure. Tighten reasonably. If sealing water does not flow while pump operates, replace packing. If packing is wearing too quickly, replace scored shaft sleeves and keep water seeping for lubrication.
34. Casing distorted by excessive strains from suction or discharge piping.	Check alignment. Examine pump for friction between impeller and casing, worn wearing rings. Replace damaged parts.
35. Shaft bent, due to thermal distortion, damage while overhaul, or improper assembly of rotating element.	Check deflection by turning between lathe centers. Arrange total run-out, should not exceed .006" on low speed pump, and not more than .003" on high speed unit.
36. Mechanical failure of critical pump parts.	Check bearings, wearing rings, bushings and impeller for damage. Any irregularity in these parts will cause a drag on the shaft.
37. Misalignment.	Realign pump and driver.
38. Speed may be too high (brake hp of pump varies as the cube of the speed; therefore, any increase in speed means considerable increase in power demand.)	Check voltage on motor and governor on turbine or engine.
39. Electrical defects.	The voltage and frequency of the electric current may be lower than that for which the motor was built; or there may be defects in the motor. The motor may not be ventilated properly due to a poor location.
40. Mechanical defects in turbine, engine, or other type of drive exclusive of motor.	If trouble cannot be located, call in factory service engineer.

19. Spare Parts

The pumps covered by this instruction book have been designed and built with all wearing parts replaceable. A recommended inventory of spare parts is dependent upon the application and the importance of continued operation.

Where pump shut down time is critical:

1—Complete rotating element with bearings and pump half coupling
1—Set of bearings
1—Set of coupling bushings (if pin and bushing type coupling is used)
1—Sheet gasket material
1—Set Special gaskets
1—Set stuffing box packing

Where another unit can carry the load and shut down time is not critical:

2—Impeller rings
2—Casing rings
2—Shaft sleeves
1—Set bearings
1—Sheet gasket material
1—Set Special gaskets
1—Set Stuffing box packing

Parts should be ordered as far in advance of their use as possible since circumstances beyond the control of the Company may reduce existing stocks. In addition, not all parts are stocked at the factory, and must be manufactured for each order.

Give serial number and rating as stamped on name plate of pump when ordering parts. Itemize parts with the name and the number of each part, and please be specific as to the quantity of each part required. Special care in furnishing the above information with the original order for parts will facilitate quick shipment.

If parts are required made of different materials than originally specified, give exact requirements and the reason for changing.

Spare parts should be carefully stored and kept covered with grease so that they will not rust.

Spare rotating elements for multi-stage pumps should always be suspended from the coupling in a vertical position. If allowed to remain stored in a horizontal position, they may receive a permanent deflection which will cause trouble when the pump is assembled.

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Toronto, Ontario, 629 Adelaide St. W.	Empire 4-0486
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Offices and distributors located throughout the world

ALLIS-CHALMERS MANUFACTURING COMPANY
Milwaukee 1, Wis.

Printed in U. S. A.

LIST OF PARTS

Part No.	Name of Part
1	Casing
2	Impeller
2A	Impeller
2B	Impeller
2C	Impeller
2L	Impeller
2R	Impeller
2U	Impeller
3	Casing Ring
3A	Casing Ring
3L	Casing Ring
3U	Casing Ring
4	Impeller Ring
4A	Impeller Ring
4L	Impeller Ring
4U	Impeller Ring
7	Shaft
7L	Shaft
7U	Shaft
8	Casing Bushing
8A	Casing Bushing
8C	Casing Bushing
8T	Casing Bushing
9	Shaft Sleeve
9C	Shaft Sleeve
9L	Shaft Sleeve
9M	Shaft Sleeve
9T	Shaft Sleeve
9U	Shaft Sleeve
10	Waterseal Pipe
11	Waterseal Valve
12	Packing
12A	Packing
12B	Packing
12C	Packing
13	Seal Cage
14	Gland
14A	Gland Bolt
15	Shaft Sleeve Nut
15C	Shaft Sleeve Nut
15L	Shaft Sleeve Nut
15M	Shaft Sleeve Nut
16	Oil Hole Cover
17	Bearing Shell
18	Bearing Cap
18C	Bearing Cap
18T	Bearing Cap
20	Bearing Bushing
21	Thrust Bearing Shell
22	Thrust Bearing Sleeve
23	Impeller Nut
24	Oil Deflector
24A	Deflector Sleeve
25	Ball Bearing Housing
25C	Ball Bearing Housing
25T	Ball Bearing Housing
26	Ball Bearing
26C	Ball Bearing
26T	Ball Bearing
27	Retaining Nut
27C	Retaining Nut
27T	Retaining Nut
28	Ball Bearing Retaining Cap
28C	Ball Bearing Retaining Cap
28L	Ball Bearing Retaining Cap
28T	Ball Bearing Retaining Cap
29	Oil Ring
29C	Oil Ring
29T	Oil Ring
30	Lower Half Bearing Housing

Part No.	Name of Part
30C	Lower Half Bearing Housing
30T	Lower Half Bearing Housing
31	Coupling
31P	Coupling
32	Bearing Adjusting Nut
34	Interstage Bushing
34A	Interstage Bushing
34B	Interstage Bushing
35	Interstage Sleeve
35A	Interstage Sleeve
40	Grease Fitting
42	Shims
52	Bearing Seal Ring
53	Cooling Fan
54	Oil Vent
55	Kingsbury Housing
56	Thrust Bearing Shoe
57	Thrust Shoe Retaining Ring
58	Kingsbury Bearing Adjusting Ring
60	Thrust Shoe Retaining Block
63	Cover Plate
73	Stuffing Box
73C	Stuffing Box
73T	Stuffing Box
80	Lock Clip
81	Spring Lock Nut
86	Ball Bearing Ring
87	Ball Bearing Adapter
88	Gland Cover
88A	Gland Cover
124	Oil Pump
127	Regainer Cover
131	Bearing Jacket
134	Boot Cord
138	Stuffing Box Shaft Sleeve
140	Motor Support
142	Interstage Diaphragm
145	End Plate
152	Packing Base Ring
153	Washer
154	Spacer Bushing
159	Bearing Seal Ring
160	Oil Pump Coupling
161	Boot Cord
162	Impeller Retaining Collar
172	Shaft Tube
183	Bearing Seal Ring
185	Oil Sight Flow Gauge
190	Sleeve Bearing
192	Oil Pump Adapter Housing
197	Impeller Key
197A	Impeller Key
198	Coupling Key
207	Pump Base Ring
208	Shaft Sleeve Key
208A	Shaft Sleeve Key
209	Discharge End Head
216	Bearing Sleeve Key
218	Tank
219	Flange Pipe
245	Dowel
257	Round Gasket
257A	Round Gasket
257B	Round Gasket
309	Stuffing Box Nut
313	Internal Bearing Seal
314	Barrel
315	Barrel End Head
316	Gland Ring

INSTRUCTIONS FOR ORDERING PARTS

When ordering parts, give model number, serial number and rating as stamped on name plate of pump. Itemize parts with names and numbers as indicated on the section drawings. Be specific as to number of parts required. Special care in following the above instructions with the original order for parts will facilitate quick shipment.

If parts are required made of different material than originally specified specify exactly the requirements and reason for changing.

Approved For Release 2000/09/01 : CIA-RDP83-00423R001000330002-2

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Handy Guide TO SELECTION OF CENTRIFUGAL PUMPS

ALLIS-CHALMERS

INDEX

TO ECONOMICAL PUMPING UNITS FOR EVERY INDUSTRY

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LONG EXPERIENCE

Sixty-eight years of experience in designing and building centrifugal pumps goes to work for you when you specify Allis-Chalmers. A-C was one of the *first companies* to see the possibilities of centrifugal design . . . to develop a *complete* line of high efficiency centrifugal pumps. This engineering background is your assurance of the *right* pump for your job.

DIVERSIFIED LINE

A-C has developed a broad line of pumps applicable to most industries. Whether you need a pump for handling clear liquid, corrosive or abrasive liquids, or liquids containing large percentages of solids in suspension, contact an Allis-Chalmers representative for the *one* pump that will meet your particular requirements.

APPLICATION ENGINEERING

Competent application engineers are at your service to give you assistance in selecting the proper type and size of pump for your particular job. At the same time, they will make recommendations regarding the appropriate type and size of drive. They help you plan, not only for the immediate future, but for the years to come.

COMPLETE TESTING

Allis-Chalmers pumps are given a complete and careful test before they are shipped from the factory. They are tested with the latest electronic and hydraulic measuring and recording instruments in the newest, most complete and most modern test floor in the industry. A copy of the actual performance curve is available for each pump.

Guide to Selection of Allis-Chalmers Centrifugal Pumps

Requirements	WATER			OTHER LIQUIDS									
	Clear			Viscous			Volatile	Corrosive	Hot °F	Containing Solids			
	Cold	Hot °F	Salt	High	Medium	Low				Abrasive	Lumpy	Pulpy	Fibrous Stringy
Fractional Hp	•					•							
Compact, close-coupled, built-in special motor	•	250 max	SM			•	•	SM	250 max				
Close-coupled, larger range, use standard motors	•	250 max	SM			•	•	SM	250 max	Limited to			
Frame type, good range, uses any power	•	•	SM			•	•	SM	550 max	Low			
Low to High Capacity double suction, 1 stage	•	250 max	SM		•	•	•	SM	250 max	Percentage			
High Head, small single; double suction to 13 stages	•	•	SM			•	•	SM	600 max				
Fire	•		SM										
Abrasive Suspensions			•	•	•	•				•	•	•	•
Paper Pulp			•	•	•	•		•			•	•	•
Non-Clogging	•		•	•	•	•				•	•	•	•
Abrasive and Corrosive	•	•	•		•	•		•	•	•	•		•
Sand — Slimes				•	•	•		•		•	•		•
Marine	•	•	•			•							
Coolant and Circulating	•		SM			•				•			
Mixed and Axial Flow	•		SM		•	•		SM			SM	SM	

NOTE: (•) means standard pump is usually suitable for normal conditions of operation.
(SM) means with special materials or construction.

CONTINUOUS RESEARCH

The reputation for A-C pumps for long, heavy duty service with little or no maintenance is the result of a continuous research program, designed to give you the *best quality* possible and the *lowest cost* possible per gallon pumped.

UNIT RESPONSIBILITY

Allis-Chalmers also builds a complete line of induction, synchronous, and direct current motors, and starters to control them. *Texrope* v-belt drives are available when required. This means a "packaged" unit, with every part engineered to work efficiently with each other . . . better operation, lower costs, undivided responsibilities. And Allis-Chalmers stands behind every unit 100%!

PROMPT SHIPMENT

Although many A-C pumps are made to order, they can be shipped in a reasonable length of time. Many other types are carried in stock, or can be quickly assembled from parts carried in stock.

NATIONWIDE SERVICE

Allis-Chalmers sales offices are conveniently located in all principal cities from coast to coast. (See the listing on page 16 of this insert.) Contact the representative in your area for additional information. He is trained in equipment engineering—knows how to look for ways to help you speed production and cut costs with modern equipment that's *right* for *your* job. In addition, A-C distributors and Certified Service shops are also conveniently located throughout the country. Or write for your information direct to Allis-Chalmers, Milwaukee 1, Wis.

further information is on the following pages

PUMP DATA													The A-C Pump	
Gallons (minute)		Head (feet)	Size inlet x outlet (inches)		Motor hp		Drives			Mounting Positions				
							Motor		Belt					
Min.	Max.	Max.	Min.	Max.	Min.	Max.	Close-Coupled	Coupling	V or Flat	Horizontal	Vertical	Other		
—	80	125	1 x ¾	1½x1½	⅓	2	•			•	•	•	Fractional Hp	11
10	500	220	1¼x1¼	5 x 4	¾	10	•			•	•	•	*Electrifugal*	4
10	2,500	550	1 x ¾	10x 8	¼	125	•			•	•		Supporting Adapter	4
10	2,500	550	1 x ¾	8 x 6	¼	125		•	•	•			Type SS-B	4
30	7,000	475	2 x1½	18x16	¾	450		•		•	•		Type S	6
10	2,500	3000 psi	2½x2½	12x10	15	2500	•	•		•			Multi-Stage	8
500	1,500	130 psi	6 x6	10x10	40	200		•		•			Fire	8
175	10,000	270	4 x3	16x14	3	200			•	•			Solids CW	9
175	10,000	270	4 x3	16x14	3	200		•	•	•	•		Paper Pulp PW & TV	9
125	11,000	120	4 x4	16x14	3	200		•	•	•	•		Sewage SW	10
15	1,300	260	2 x1½	6 x 4	1	100		•	•	•			Process P	11
10	2,400	100	2 x2	10x 8	½	100		•	•	•	•		Rubber-Lined SRL	10
10	7,000	475	1¼x1¼	18x16	1	450	•	•		•	•		Marine	12
—	80	125	1 x ¾	1½x1½	⅓	2	•	•	•	•	•	•	Coolant — Circulating	11
3500	90,000	80	16x12	84x54	25	2000		•		•	•		Mixed and Axial Flow	12

Allis-Chalmers single stage, single suction centrifugal pumps are designed in two basic types: the close-coupled type (Figures 1 and 2) and the frame mounted type (Figure 3). The close-coupled units are available either with the pump and the motor mounted in the exclusive "unit-cast" frame (*Electrifugal* pump) or with an adapter between the pump and the motor (supporting adapter type pump). The adapter permits a wide choice of motor sizes and types.

On both the *Electrifugal* pump and the supporting adapter type pump the pump and the motor operate on the same shaft, providing perfect alignment. In the frame mounted type, the pump is a separate unit. It has ball bearings and may be used with a wide variety of prime movers and drive arrangements.

Construction

In all three units the liquid end of the pump is identical. Standard construction of each is cast iron, bronze fitted, but special materials are available to handle various liquids.

The smooth surface of the gray lacquer finish is easy to keep clean, and harmonizes with other equipment and accessories.

Features

Impellers are bronze, and are of the enclosed type, single suction, and are hydraulically balanced. Packed stuffing box is standard, but mechanical shaft seal is also available. Renewable bronze wearing rings protect the casing and the cover from wear. Bronze, replaceable shaft sleeves protect the shaft from contact with the liquid being pumped, and from scoring and other damage. The discharge nozzle can be rotated to eight different positions 45 degrees apart. Flanged and screwed connections are available.

Drives

The close-coupled *Electrifugal* and supporting adapter type pumps are driven by a motor on the unit's single shaft. The motor for the *Electrifugal* pump is especially designed and built for that pump, while supporting adapter type pumps utilize standard flange mounted induction motors of NEMA dimensions, and similarly rated dc motors. Both close-coupled type pumps are available with standard open type drip-proof, splash-proof, totally-enclosed fan-cooled, or explosion-proof motors.

Most industrial areas have one or more A-C Certified Service shops where factory approved service and genuine Allis-Chalmers replacement parts are always available.

Electrifugal Pump
capacities 10 to 500 gpm, heads to 220 ft.

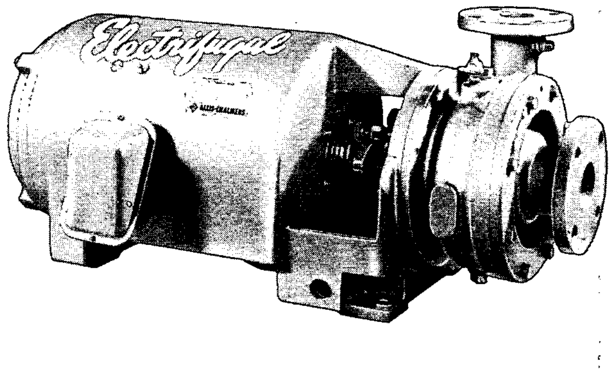


FIG. 1—*Electrifugal* pump with drip-proof motor. Splash-proof, totally-enclosed fan-cooled and explosion-proof also available.

Supporting Adapter
capacities 10 to 2500 gpm, heads to 550 ft.

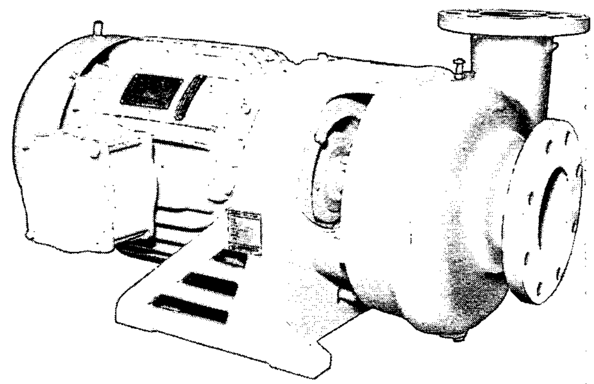
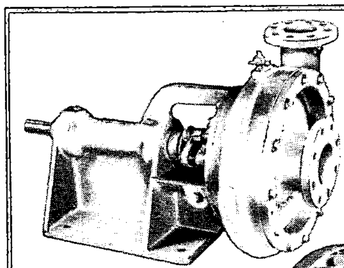
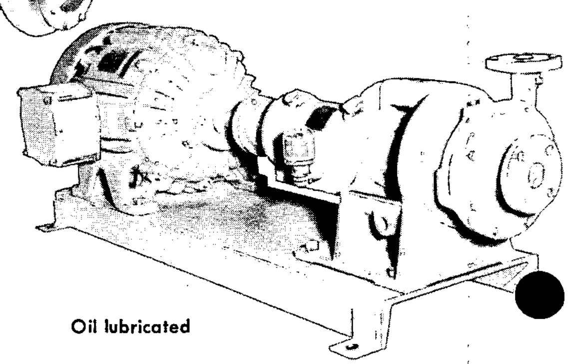


FIG. 2—Supporting adapter pump with explosion-proof motor. Other types of motors available to suit application.

Frame Mounted
capacities to 10 to 2500 gpm, heads to 550 ft.



Grease lubricated



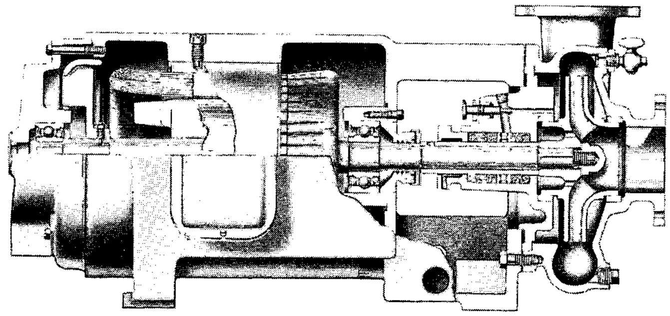
Oil lubricated

Motor and pump operate on a single shaft and are mounted in the exclusive "unit-cast" frame which has no adapter or joints between motor and pump. Alignment is perfect and permanent.

Electrifugal pumps can operate in almost any position, and are adaptable to installations requiring special mountings—such as the side of machinery, apparatus, tanks, walls, or where space is limited. Four wide-spread feet, cast integral with the frame, give unusually stable mounting. All cast iron motor construction resists corrosive atmospheres.

Motor is designed especially for the *Electrifugal* pump. Multiple-dipped and multiple-baked stator has great mechanical and electrical strength. Rotor is die-cast aluminum. Four-way sealing arrangement prevents seepage from entering bearing seal and motor. Both motor bearings are lubricated and sealed at the factory, eliminating bearing maintenance.

Bulletin 52B6140

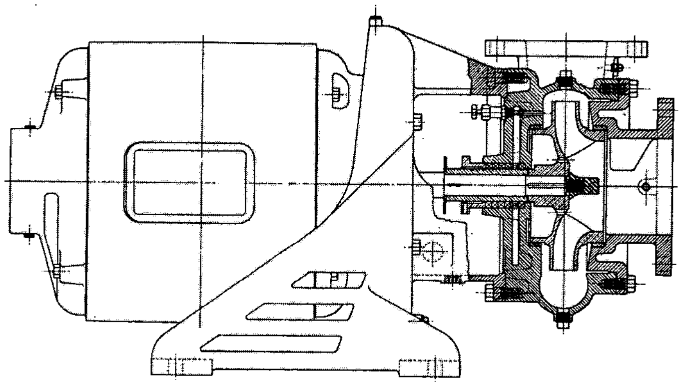


Typical *Electrifugal* pumping unit cutaway to show details of construction. Motor was designed and built especially for this pump.

Developed from the original close-coupled pump first built in 1926 by Allis-Chalmers. It covers the range of sizes larger than the *Electrifugal*. It may be used with any motor having a NEMA Type C flange for mounting and a round frame.

Available in hundreds of standard ratings covering a wide range of heads and capacities, supporting adapter type pumps have applications in almost every type of industry. Supporting adapter type pump motors are of the flange type. They are bolted to the supporting frames on which the pumps are also mounted. This results in a rigid, compact construction that provides permanent alignment to the unit's single shaft. Mounting can be either horizontal or vertical. Higher head supporting adapter type pumps are built with two stages.

Bulletin 52B6083



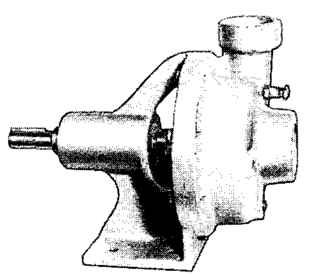
Cutaway supporting adapter pump shows construction details. Pump mounted on special supporting adapter—permits choice of motor sizes.

Frame mounted pumps have hundreds of applications ranging from the handling of chemicals to the irrigation of farm lands. These pumps are available with either grease or oil lubricated bearings, with a choice of sealing arrangements in either mechanical seal or stuffing box.

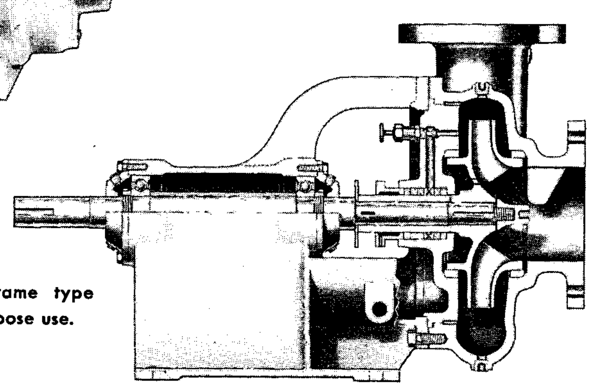
A special frame assembly has been designed for use in the chemical and petroleum industries to handle liquids up to 550 F. The pump end can be made of special materials for handling liquids which would attack iron or bronze.

Frame mounted pumps can be driven by electric motors, gasoline or diesel engines, or steam turbines, and can be direct connected or belt driven. With *Texrope* v-belt drives speed can be adjusted to suit the application.

Bulletin 52B7638 (oil lubricated), *Bulletin 52B6351* (grease lubricated).

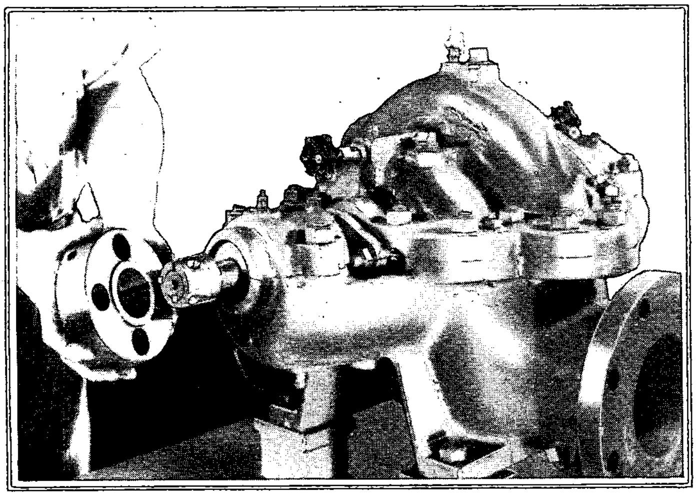


Pedestal mounted fhp pumps range up to 80 gpm with heads to 125 ft. Have wide use in many industries.

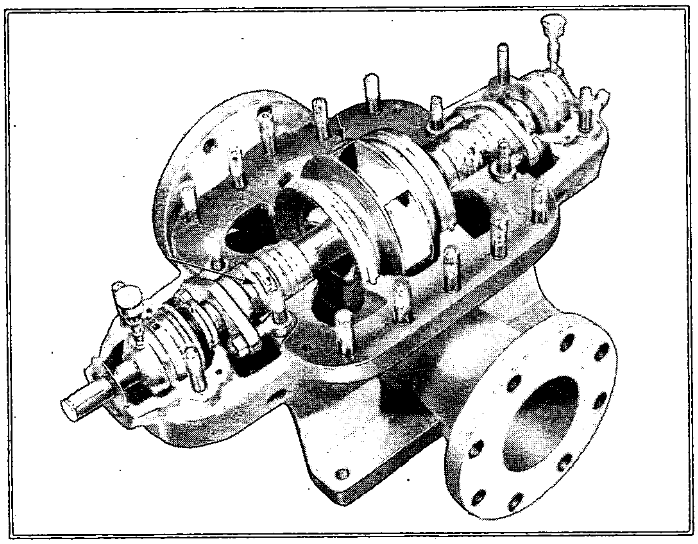


Grease lubricated frame type pump for general purpose use.

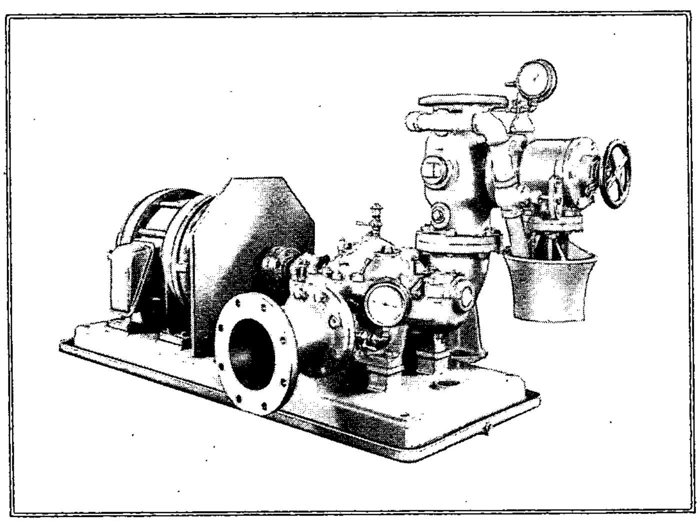
DOUBLE SUCTION PUMPS Single Stage



Mounting coupling on *Magic-Grip* bushing on shaft of type S pump.



Upper half of casing removed to show sturdy construction and complete accessibility of type S centrifugal pumps.



Suction side of Fire pump with motor and fittings.

Type S capacities to 170,000 gpm

In almost every industry the demand for high efficiency, low maintenance pumps has steadily increased. To serve this specific need Allis-Chalmers developed the Type S single stage, double suction pumps, which are individually engineered to meet your specifications.

Applications

Type S is widely employed for general water supply, circulating, gathering, drainage and other applications in the paper, mining, oil, chemical, food, and other industries, and in large and small power plants.

Sizes-Capacities

66 standard sizes with inlet and discharge openings from 2 x 1½ to 18 x 16 in. Capacities from 30 to 7000 gpm, heads to 475 ft — and taking motors from ¾ to 450 hp; 3550 to 495 rpm. Large, high-head S pumps are available in sizes up to 36 x 30 in., with capacities to 40,000 gpm; heads to 200 ft. Large, low-head S pumps are built in sizes up to 72-inch discharge, for 170,000 gpm or more.

Construction Features

Rigid streamlined-flow cast iron casing is horizontally split. Suction and discharge nozzles located in lower casing, permitting easy removal of top half for inspection. Bronze impellers are double suction enclosed type, hand finished to a smooth surface, and carefully balanced. Easily replaced bronze wearing rings protect the casing from wear. Heat treated steel shaft transmits power to impeller. Split bronze seal cages effectively prevent air from leaking into pump. Grease lubricated ball bearings are held on the shaft by a lock nut, and are protected from foreign matter by a bearing housing. Coupling has *Magic-Grip* bushing for easy installation and removal.

Bulletin 08B6146

Fire Pumps

Construction Features

Rigid cast iron casings are horizontally split for easy inspection. Bronze, balanced impellers are hand finished. Bronze wearing rings protect the casing from wear, are easily replaced. Large, high tensile strength steel shaft is heat-treated to remove stress and strain.

Fire Fittings

A set of fire fittings which can be ordered for 500, 750 and 1000 gallon capacity pumps includes: Hose valves, Discharge base elbow, Hose manifold, Relief valve, Discharge cone, Suction and discharge gauges, Vent piping. In addition, the 1500 gallon capacity pump is provided with a discharge cross.

Bulletin 08B6336

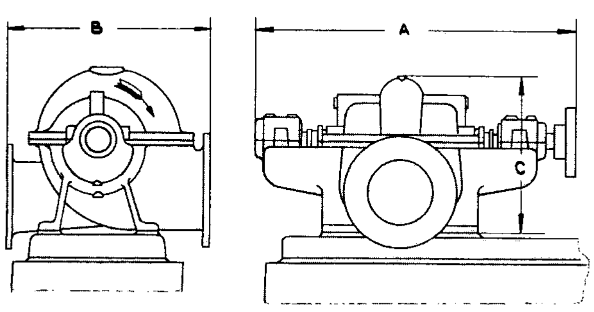
HEAD-CAPACITY TABLE . . . Type S Double Suction Pumps

CAP. U. S. GPM	TOTAL HEAD—IN FEET OF WATER . . . measured at suction and discharge nozzles																										
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150	160	170	180	190	200	225	250	275	300	325	350	375	400
30	ALCA	ALBA	ALBB	ALBC	ALBC	ALAD	ALAE	ALAE	ALAE	ALAF	ALAF	ALAF	ALAF	ALAF	ALAF	ALAG	ALAG	ALAG	ALAG	ALAG	ALAH	CNAI	CNAJ					
40	ALCA	ALBA	ALBB	ALBC	ALBC	ALAE	ALAE	ALAE	ALAE	ALAF	ALAF	ALAF	ALAF	ALAF	ALAF	ALAG	ALAG	ALAG	ALAG	ALAG	ALAH	CNAI	CNAJ					
50	ALCA	ALBA	ALBB	ALBC	ALBD	ALAE	ALAE	ALAE	ALAF	ALAF	ALAF	ALAF	ALAF	ALAF	ALAG	ALAG	ALAG	ALAG	ALAG	ALAG	ALAH	CNAI	CNAJ	CNAJ	CNAJ	CNAJ	CNAK	CNAL
60	ALCA	ALBA	ALBB	ALBC	ALBD	ALAE	ALAE	ALAE	ALAF	ALAF	ALAF	ALAF	ALAF	ALAG	ALAG	ALAG	ALAG	ALAG	ALAG	ALAH	ALAH	CNAJ	CNAJ	CNAJ	CNAJ	CNAJ	CNAK	CNAL
75	HHCA	BJBA	BJBC	ALBC	BJBD	ALAE	ALAE	ALAF	ALAF	ALAF	ALAF	ALAF	ALAG	ALAG	ALAG	ALAG	ALAG	ALAG	ALAH	ALAH	ALAI	CNAJ	CNAJ	CNAJ	CNAJ	CNAK	CNAL	CNAL
100	HHCA	BJBB	BJBC	BJBD	BJBE	ALAE	ALAE	ALAF	ALAF	ALAF	ALAF	ALAG	ALAG	ALAG	ALAG	ALAH	ALAH	ALAH	ALAH	ALAH	ALAI	CNAJ	CNAK	CNAK	CNAK	CNAK	CNAL	CNAM
125	EJBA	EJBC	EJBD	BJBE	EJBE	ALAE	ALAF	ALAF	ALAG	ALAG	ALAG	ALAG	ALAG	ALAG	ALAH	ALAH	ALAH	ALAH	ALAH	ALAH	ALAI	CNAJ	CNAK	CNAK	CNAK	CNAK	CNAL	CNAM
150	EJBB	EJBC	EJBD	EJBE	EJBE	BJAE	BJAF	BJAG	BJAG	BJAG	BJAG	BJAH	BJAH	ALAH	ALAH	BJAH	BJAH	BJAI	ALAI	ALAI	BJAI	CNAJ	CNAK	CNAK	CNAK	CNAL	CNAL	CNAM
175	EJBC	EJBC	EJBD	EJBE	EJBF	BJAF	BJAF	BJAG	BJAG	BJAG	BJAH	BJAH	BJAH	BJAH	BJAH	BJAH	BJAI	BJAI	BJAI	BJAI	EJAJ	CNAK	CNAK	CNAK	CNAK	CNAM	CNAM	CNAM
200	EJBC	EJBD	EJBE	EJBE	HHBF	EJAF	EJAG	BJAG	BJAG	BJAG	BJAH	BJAH	BJAH	BJAH	BJAH	BJAI	BJAI	BJAI	BJAI	BJAI	EJAK	CNAK	CNAK	CNAL	CNAL	CNAM	CNAM	CNAM
225	HHBC	HHBD	HHBE	EJBF	HHBF	EJAG	EJAG	EJAG	*EJAH	EJAH	BJAH	BJAH	BJAH	BJAH	BJAI	BJAI	BJAI	BJAI	BJAI	BJAJ	EJAK	CNAK	CNAL	CNAL	CNAM	CNAM	CNAM	CNAN
250	HHBC	HHBD	HHBE	EJBF	HHBF	EJAG	EJAG	EJAG	EJAH	EJAH	EJAH	EJAI	EJAI	EJAI	EJAI	EJAI	EJAJ	BJAI	BJAJ	BJAI	EJAK	CNAL	CNAL	CNAL	CNAM	CNAM	CNAN	CNAN
275	IHBC	IHBD	HHBE	HHBF	HHBF	EJAG	EJAG	EJAH	EJAH	EJAH	EJAI	EJAI	EJAI	EJAI	EJAI	EJAI	EJAJ	EJAJ	EJAJ	EJAJ	EJAK	CNAL	CNAL	CNAM	CNAM	CNAM	CNAN	CNAN
300	IHBC	IHBD	IHBE	HHBF	HHBG	HHAH	EJAH	EJAH	EJAH	EJAH	EJAI	EJAI	EJAI	EJAI	EJAI	EJAJ	EJAJ	EJAJ	EJAJ	EJAK	HHAL	HHAM	CNAM	CNAM	CNAM	CNAM	CNAN	CNAN
350	IHBC	IHBE	IHBF	IHBG	IHBG	HHAH	IHBH	HHAI	HHAI	EJAI	EJAI	EJAI	EJAI	EJAI	EJAJ	EJAJ	EJAJ	EJAJ	EJAK	EJAK	HHAM	HHAM	GKAM	GKAN	GKAN	GKAO	GKAO	GKAP
400	IHBD	IHBE	IHBF	IHBG	IHBG	IHBH	IHBH	HHAI	HHAI	HHAI	HHAJ	HHAJ	HHAJ	HHAK	HHAK	HHAK	HHAK	HHAL	HHAL	HHAL	HHAM	GKAN	GKAN	GKAN	GKAO	GKAO	GKAO	GKAP
450	IHBE	IHBF	IHBF	IHBG	IHBG	IHBH	IHBH	HHAI	HHAI	HHAI	HHAJ	HHAJ	HHAJ	HHAK	HHAK	HHAK	HHAL	HHAL	HHAL	HHAM	HHAM	GKAN	GKAN	GKAN	GKAO	GKAO	GKAP	GKAP
500	KGBE	IHBF	IHBF	IHBG	IHBH	IHBH	IHBI	HHAI	IHBI	HKBJ	HKBJ	HKBJ	HHAJ	HHAK	HHAK	HHAK	HHAL	HHAL	HHAL	HHAM	HHAM	GKAN	GKAO	GKAN	GKAO	GKAO	GKAP	JKAP
550	KGBF	KGBF	IHBG	IHBG	IHBH	IHBH	IHBI	IHBI	HKBJ	HKBJ	HKBJ	HKBK	HKBK	HHAK	HHAK	HHAK	HHAL	HHAM	HHAM	HHAM	JKAN	GKAO	GKAO	GKAM	GKAO	GKAP	GKAP	JKAP
600	NFDE	KGBF	KGCF	KGCG	KGBH	KGBI	KGBI	KGBJ	KGBJ	KGBK	HKBK	HKBL	HKBL	HKBL	JKAL	JKAM	JKAM	JKAM	JKAM	JKAM	JKAN	JKAO	JKAP	JKAP	JKAP	JKAP	JKAQ	JKAQ
650	NFDE	KGBF	KGCF	KGBH	KGBH	KGBI	KGBI	KGBJ	KGBK	KGBK	JJBK	HKBL	HKBL	HKBL	JKAL	JKAM	JKAM	JKAM	JKAM	JKAN	JKAO	JKAO	JKAP	JKAP	JKAQ	JKAP	JKAQ	JKAQ
700	NFDE	KGBF	KGBG	KGBH	KGBH	KGBI	KGBJ	KGBJ	KGBK	KGBK	JJBK	JJBL	JJBL	JJBM	JJBM	JHAM	JHAN	JHAN	JHAN	JHAN	JHAO	JKAP	JKAP	JKAP	JKAQ	JKAQ	JKAQ	JKAQ
750	NFDE	NFCF	KGBG	KGBH	KGBI	KGBI	KGBJ	KGBJ	KGBK	KGBL	JJBL	JJBM	JJBM	JJBM	JJBM	JHAM	JHAN	JHAN	JHAN	JHAN	JHAO	JKAP	JKAP	JKAP	JKAQ	JKAQ	JKAQ	JKAQ
800	NFDE	NFCF	NFCG	KGBH	KGBI	KGBI	KGBJ	KGBJ	KGBK	KGBL	JJBL	JJBM	JJBM	JJBM	JJBM	JHAM	JHAN	JHAN	JHAN	JHAN	JHAP	JKAP	JKAP	JKAQ	JKAQ	JKAQ	JKAQ	JKAR
900	NFDF	NFBG	NFBH	NFBI	NFBI	KGBJ	KGBJ	KGBK	KGBL	KGBL	JJBM	JJBM	JJBM	JJBM	JJBN	JHAN	JHAN	JHAN	JHAO	JHAO	JHAP	JKAP	JKAQ	JKAQ	JKAQ	JKAQ	JKAR	JKAR
1000	NFDF	NFBG	NFBH	NFBI	NFBI	NFBJ	NFBK	NFBL	NFBM	NFBM	MJBM	MJBN	MJBN	MJBN	MJBO	MGAN	MGAO	MGAO	MGAO	MGAO								
1100	PFDF	PECG	OFCH	NFBI	NFBJ	NFBJ	NFBK	NFBL	NFBM	NFBM	MJBN	MJBN	MJBN	MJBO	MJBO	MGAO	MGAO	MGAP	MGAP	MGAP								
1200	PFDF	PECG	OFCI	NFBI	NFBJ	NFBK	NFBL	NFBL	NFBM	OFBN	MJBN	MJBO	MJBO	MJBO	MJBO	MJBP	MJBP	MJBP	MJBP	MJBP								
1300	PFDF	PECH	PFCI	NFBI	NFBJ	NFBK	NFBL	NFBM	NFBM	OFBN	OHBN	OHBO	OHBO	OHBO	OHBP	MJBP	MJBP	MJBP	MJBP	MJBQ								
1400	PFDG	RECH	PFCI	PEBJ	PEBK	NFBK	NFBL	NFBM	NFBM	OFBN	OHBN	OHBO	OHBO	OHBO	OHBP	MJBP	MJBP	OIBQ	OIBQ	OIBQ								
1500	PFDG	RECH	PFCI	PEBJ	PEBK	PEBL	OFBM	OFBM	OFBN	OFBN	OHBN	OHBP	OHBO	OHBP	PHBP	PHBQ	PHBQ	OIBQ	OIBQ	OIBQ								
1600	RFDG	RECH	PFGI	PEBJ	PEBK	PEBL	OFBM	OFBM	OFBN	OFBO	PHBO	PHBP	PHBP	PHBP	PHBP	PHBQ	PHBQ	OIBQ	OIBQ	OIBQ								
1700	RFDG	RECH	RECJ	PEBK	PEBL	PEBM	OFBM	OFBM	OFBN	OFBO	PHBO	PHBP	PHBP	PHBP	PHBP	PHBQ	PHBQ	OIBQ	OIBQ	OIBQ								
1800	RFDG	RECI	RECJ	PEBK	PEBL	PEBM	OFBM	OFBN	OFBN	PFBO	PFBO	PFBP	PHBP	PHBP	PHBQ	PHBQ	PHBQ	PHBQ	PHBQ	PHBR								
1900	RFDG	RECI	RECJ	PEBK	PEBL	PEBM	PFBM	PFBN	PFBO	PFBO	PFBP	PFBP	PHBP	PHBQ	PHBQ	PHBQ	PHBQ	PHBR	PHBR	PHBR								
2000	RFDH	RECI	RFCJ	REBK	PEBL	PEBM	PFBN	PFBN	PFBO	PFBO	PFBP	PFBQ	PHBQ	PHBQ	PHBQ	PHBQ	PHBR	PHBR	PHBR	PHBR								
2250	RFDH	RECI	RFCK	REBL	REBM	REBM	REBN	PFBO	PFBP	PFBP	PFBP	PHBQ	PHBQ	PHBQ	PHBR	PHBR	PHBR	PHBR	PHBS	PHBS								
2500	TEDI	TEDJ	TECL	REBL	REBM	REBN	REBN	RFBP	RFBP	RFBP	RFBQ	PHBQ	PHBQ	PHBQ	PHBR	PHBR	PHBR	PHBS	PHBS	PHBS								
2750	TDEI	TDDJ	TDDK	TECM	TECN	REBN	SGCO	RFBP	SGCP	RFBQ	RFBQ	SGBR	SGBR	SGBR	QHBS	QHBS	QHBS	QHBT	QHBT	QHBT								
3000	TDEI	TDDJ	TDDL	TECM	TECN	REBO	SGCO	SGCP	SGCP	RFBQ	RFBQ	SGBR	SGBR	SGBR	QHBS	QHBS	QHBS	QHBT	QHBT	QHBT								
3250	TDEI	TDDJ	TDDL	WEDM	SHDN	SHDO	SHCP	SGCP	SGCQ	SGBQ	RFBR	SGBR	SGBR	SGBS	SGBS	SGBS	SGBT	QHBT	QHBT	QHBT								
3500	TDEI	TDDK	TDDM	WEDM	SHDO	SHDO	SHCP	SGCP	SGCQ	SGBR	SGBR	SGBR	SGBS	SGBS	SGBS	SGBT	SGBT	SGBT	SGBT	QHBU								
3750	TDEI	TDDK	TDDM	WEDN	SHDO	SHDP	SHCP	SGCQ	SGCR	SHCR	SGBR	SHCS	SGBS	SGBS	SGBT	SGBT	SGBT	SGBT	SGBU	SGBU								
4000	TDEJ	TDDL	WEDM	WEDN	SHDO	SHDP	SHCQ	SHDQ	SGCR	SHCR	SGBR	SHCS	SGBS	SGBT	SGBT	SGBT	SGBT	SGBU	SGBU	SGBU								
4250	WEFI	WEEL	WEDM	WEDN	WEDP	SHDP	SHCQ	SHDQ	SHCR	SHCR	SHCS	SHCS	SHCT	SGBT	SGBT	SGBT	SGBU	SGBU	SGBU	SGBV								
4500	WEFJ	WEEL	WEDM	WEDO	WEDP	SHDQ	SHCQ	SHDQ	SHCR	SHCS	SHCS	SHCT	SHCT	SHCT	SGBT	SGBU	SGBU	SGBU	SGBU	SGBV								
4750	WEFJ	WEEL	WEDM	WEDO	WEDP	SHDQ	SHCQ	UHDR	SHCR	SHCS	SHCS	SHCT	SHCT	SHCT	SHCU	SHCU	SHCV	SICV	SICV	SICV								
5000	XFIJ	WEEL	WEDN	WEDO	WEDP	WECQ	WECR	UHDR	UHDR	SHCS	UHDT	SHCT	SHCT	SHCU	SHCU	SHCU	SHCV	SICV	SICV	SICW								
5500		XFGM	WEEN	WEDP	WEDQ	WECQ	WECR	UHDS	UHDR	UHDT	UHDT	SHCT	SHCU	SHCU	SHCU	SHCV	UHCV	UHCV	UHCW	UHCW								
6000		XFGM	XFFO	WEDP	WEDQ	WECR	WECR	UHDS	UHDR	UHDT	UHDT	UHDU	UHCU	UHCU	UHCV	UHCV	UHCW	UHCW	UHCW	UHCX								

KEY TO FIRST AND SECOND LETTERS

(Includes Approximate Dimensions in inches)

KEY	PUMP	A	B	C
AL	2 x 1½SL	18 ⅞	13 ½	10
BJ	2½x 2 SJ	21 ⅜	15	11 ⅛
CN	3 x 1½SN	27 ¼	17 ¾	14
DK	3 x 2 SK	25 ¾	19 ½	15 ½
EJ	3 x 2½SJ	21 ⅜	15 ¾	11 ¼
EK	3 x 2½SK	27 ¼	19 ½	16
FL	4 x 2 SL	30 ¼	19 ¼	14 ⅞
GK	4 x 2½SK	27 ½	17 ¾	14 ¾
HH	4 x 3 SH	27 ¼	17	11 ¾
HK	4 x 3 SK	30 ¼	22	18
IH	4 x 4 SH	30 ¼	19	14 ¾
JH	5 x 4 SH	30 ¼	20 ⅞	13 ¼
JJ	5 x 4 SJ	30 ¼	24 ½	20 ¾
JK	5 x 4 SK	31 ¼	23	16 ⅜
KG	5 x 5 SG	30 ¼	20 ¼	16 ¼
LJ	6 x 3 SJ	33	22 ¼	18 ¼
MG	6 x 5 SG	33	22 ½	17 ⅞
MJ	6 x 5 SJ	43 ⅞	28	21 ½
MK	6 x 5 SK	43 ⅞	25	17 ⅛
NF	6 x 6 SF	33	21 ¼	17 ¼
OF	8 x 6 SF	37 ⅛	24 ⅛	18 ⅞
OH	8 x 6 SH	41 ⅞	28	20 ⅞
OI	8 x 6 SI	43 ⅞	31	23 ½
PE	8 x 8 SE	37 ⅛	24 ⅛	19 ½
PF	8 x 8 SF	43 ⅞	28	30 ⅝
PH	8 x 8 SH	43 ⅞	35	23 ⅞
QH	10 x 8 SH	55 ⅜	38	24 ⅝
QJ	10 x 8 SJ	47 ⅝	46	31 ½
RE	10 x10 SE	43 ⅞	29	20 ⅝
RF	10 x10 SF	43 ⅞	32	22 ⅛
SG	12 x10 SG	58 ⅜	42	26 ¾
SH	12 x10 SH	59 ¼	42	31 ⅛
SI	12 x10 SI	59 ¼	46	37
TD	12 x12 SD	53 ⅞	36	34 ⅜
TE	12 x12 SE	49 ⅜	36	24 ¾
UH	14 x12 SH	63 ½	54	38 ⅝
VD	14 x14 SD	48 ⅜	38	21 ½
WD	16 x14 SD	54 ½	42	37 ⅜
WE	16 x14 SE	60 ⅜	42	35
XF	16 x16 SF	67 ½	50	43 ½



KEY TO THIRD LETTER:

KEY	RPM	KEY	RPM	KEY	RPM
A	3600	D	900	G	510
B	1800	E	720	H	450
C	1200	F	600	I	400

KEY TO FOURTH LETTER:

KEY	HP	KEY	HP	KEY	HP
A	¾	I	15	Q	100
B	1	J	20	R	125
C	1½	K	25	S	150
D	2	L	30	T	200
E	3	M	40	U	250
F	5	N	50	V	300
G	7½	O	60	W	350
H	10	P	75	X	400

MULTI-STAGE PUMPS Single and Double Suction

Double Suction

capacities to 10,000 gpm, heads to 2500 ft

Applications

Double suction multi-stage units designed for pumping clear liquids against high heads over a wide range of applications—general water supply systems, boiler feed, and industrial fire protection systems. Special type for pipe line service transporting oil to refineries.

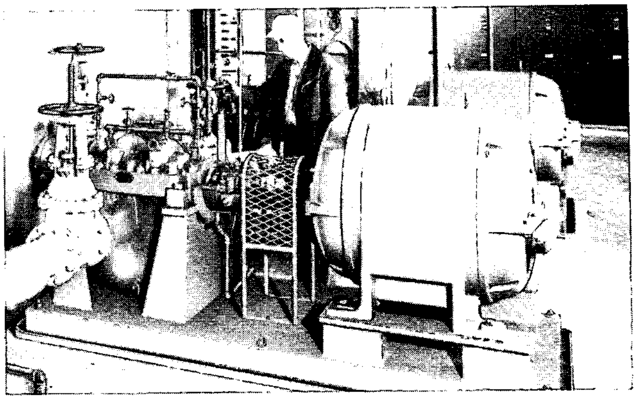
Construction Features

Horizontally split casing of high-test iron with suction and discharge nozzles in lower half, permitting inspection and maintenance without disconnecting piping. Bronze, double suction, enclosed type impellers are hydraulically balanced, hand finished. Bronze casing wearing rings easily replaced. Heat treated, carbon steel shafts, ground to close tolerances. Shaft sleeves through stuffing box and between impellers are stainless steel or aluminum bronze. Interstage bushings between stages. Ball bearings are enclosed, double row type with split caps for easy inspection and replacement. Large sizes have babbitted sleeve bearings combined with Kingsbury type thrust bearing. Pressure-reducing bushing provided between last stage and stuffing box, protects casing from wear, reduces pressure on stuffing box.

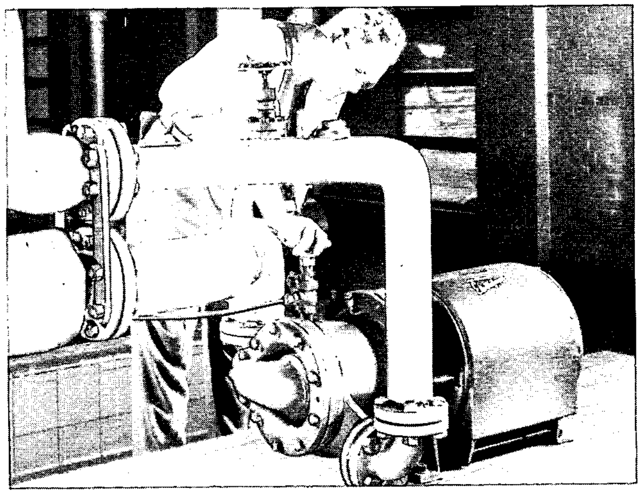
Single Suction

capacities to 300 gpm, heads to 575 ft

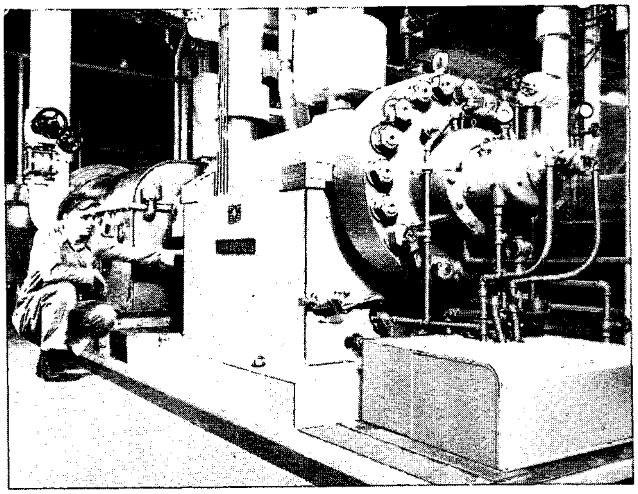
Compact, efficient SS-Multi pumps operate economically over wide range of applications—boiler feed, humidifier and air conditioning service, high lift pumps for buildings, small mine pumps, and for oil feed operations.



Type M double suction, multi-stage pumps with Allis-Chalmers motors and control.



Two-stage single suction *Electrifugal* pump used for boiler feed service.



Twelve-stage barrel-type boiler feed pump rated 480 gpm, 4271 ft head. Driven by 800 hp Allis-Chalmers motor.

Barrel Type Pumps

These pumps were developed to meet the demand for increased boiler pressure requirements. This line of single suction pumps is for the high pressure ranges of approximately 1200 to 3000 pounds, with capacities from 300 to 2500 gpm, and is available with five to 13 stages. Each of the many individual features of this pump has been exhaustively tested and proved satisfactory for high pressure requirements.

Opposed arrangement of stages and volute construction assure good axial and radial balance. Split inner casing simplifies maintenance. Main horizontal joint of inner casing uses full hydraulic discharge pressure to keep joint in compression. Double suction, with resulting low NPSH on first stage reduces possibility of flashing. Uniform metal section thickness throughout volute casing equalizes expansion.

Solids Handling . . type CW

capacities to 10,000 gpm, heads to 270 ft

Applications

For coal washing, and in process, metal, sand and gravel industries, for pumping slurries, tailings, sludges, gypsum, bauxite, dredge water, and many other solutions containing large percentages of suspended solids.

Sizes and Capacities

Eight sizes from 4 x 3 to 16 x 14 inches provide a wide capacity range from 175 to 10,000 gpm, heads to 270 ft.

Construction Features

Comparable size units of different ratings have interchangeable parts. Rotating element can be removed without disturbing piping. Double row ball bearings on largest sizes. Spherical seat double roller bearings take sheave load. Synthetic rubber seals keep foreign matter from entering bearing housing. Made of special, highly abrasion-resisting alloyed iron, *Ni-Hard* standard on impeller and wear plate.

Bulletin 08B6381

Paper Stock . . type PW

capacities to 10,000 gpm, heads to 270 ft

Applications

Designed with heavy-duty shaft and bearings to handle high consistence pulp in paper, chemical, brewing, and distilling industries.

Sizes and Capacities

Nine sizes, 4 x 3 to 16 x 14 inches provide a capacity range from 175 to 10,000 gpm, heads to 270 ft.

Construction Features

Same features as those of the CW pump (above). Made of materials to suit application. Universal joint spacer type coupling adapted to pump and motor shafts with *Magic-Grip* bushing used on direct driven units, withstands misalignment up to ⅛ in. Coupling guard is standard equipment. Optional construction includes a 16-inch suction adapter with feeder vane assembly.

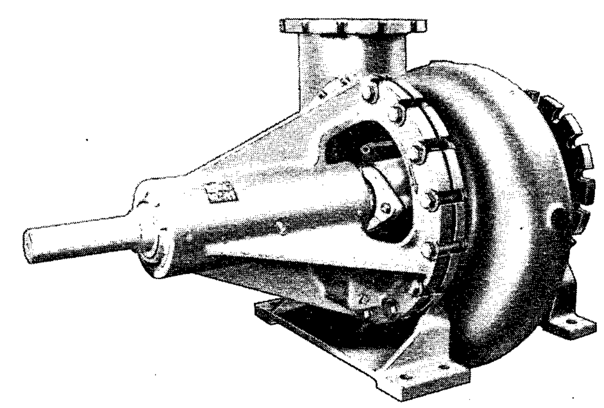
Bulletin 08B6725

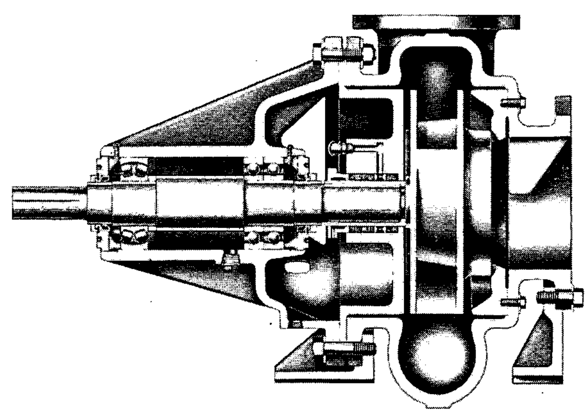
Hi-Density Feeder

Consists of shaft and multiple vane assembly which moves pulp into pump suction at rate *pump* is designed to move it to next operation. With this *Hi-Density* Feeder, A-C paper stock pumps can handle up to 8 percent bone dry consistence *without* air binding.

Bulletin 08B7112

The pumps, except the rubber-lined, shown in this section, are of the same basic design and appearance. However, each pump meets a specific demand in handling various types of liquids containing solids in suspension—whether of a granular, pulpy, stringy, or fibrous nature—either corrosive or abrasive. These pumps are of rugged construction to withstand severe operating conditions . . . designed with few working parts . . . with all parts readily accessible . . . are easy to dismantle and reassemble for inspection or maintenance.



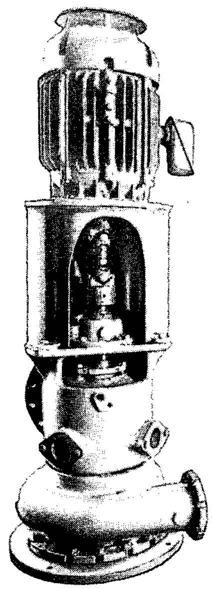


Section through paper stock pump shows sturdy compact construction, accessibility of all parts.

Paper Stock . . . type TV

capacities 10,000 gpm, heads to 270 ft.

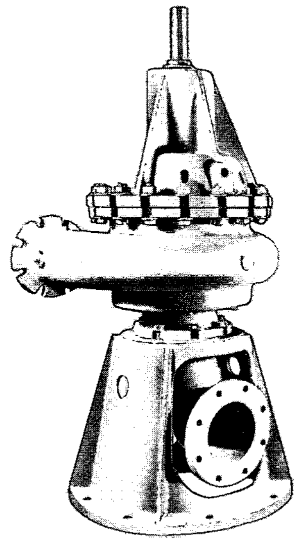
The new TV pump takes one-fourth the floor space of horizontal units. Motor is bolted directly to motor pedestal, connected through universal joint spacer coupling. No close alignment necessary. Open motor pedestal allows easy access to universal joint type coupling, yet maintains rigid alignment. Stuffing box is easy to get at, making inspection and proper maintenance simple. 16-inch suction opening on all pump sizes means low velocity at suction. Stock feed into eye of impeller is accelerated by gravity. Heavier stocks can be handled without difficulty Most air binding problems are eliminated.



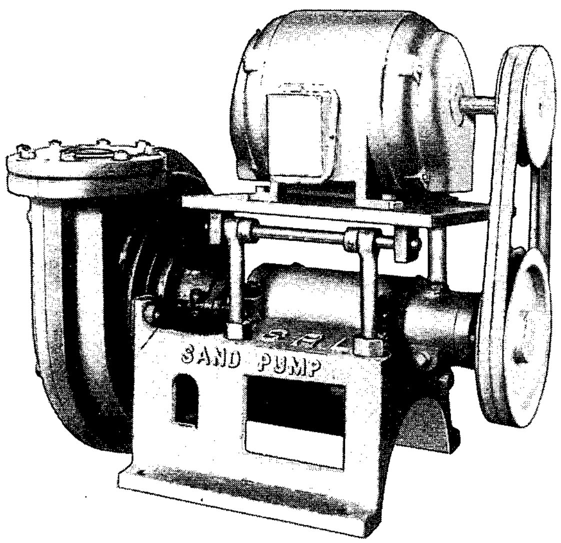
Sewage . . type SW

capacities to 11,000 gpm, heads to 125 ft

Sewage pumps are available in either vertical or horizontal settings. Horizontal pumps are mounted on a rigid, steel baseplate. Vertically mounted pumps have either an intermediate shaft or a driving motor mounted directly on the pump.



Special impellers were designed to pass maximum sphere sizes, rags, strings, and other materials encountered in pumping sewage. Standard pump is all cast iron fitted, however, alternate construction with bronze fittings is available. Pumps are connected to the driver by a universal joint coupling fitted with *Magic-Grip* bushings to facilitate removal and installation. Coupling guard and suction nozzle with clean-out cover provided.



SRL pump with motor mounted on pump to save floor space.

Rubber-Lined Pumps types SRL, SRL-C

capacities to 2400 gpm, heads through 100 ft

Applications

Designed for handling abrasive sands and slimes in the mining industry. Gives outstanding service handling liquids containing solids in suspension, from ⅛ inch to 325 mesh.

Construction Features

Impellers are of non-choke design, available in either the open (SRL) or the closed (SRL-C) type. Rubber lining is pressure molded on steel skeleton and pressed into casing. Lining may be renewed without removing pump from location. Rubber compound is engineered to fit specific application.

SIZES: SRL — 2x2, 3x3, 5x5, 6x6;
SRL-C — 3x3, 5x4, 8x6 10x8.

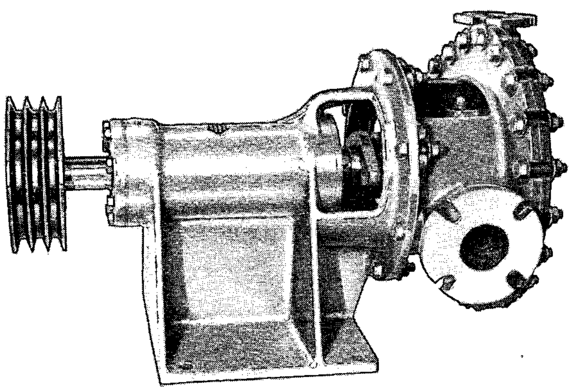
Bulletin 08B7311

Process Pump . . types P, PD

capacities to 1300 gpm, heads to 260 ft.

Applications

For handling corrosive and abrasive liquors, particularly corrosive liquors having abrasives in suspension. Larger size pumps designed with double volute casings to reduce radial unbalance of severe operating conditions, are designated Type PD.



Sizes and Capacities

Five individual sizes: Type P with heads to 110 ft, 2 x 1½ and 3 x 2 inches. Type PD with heads to 260 ft, 3 x 2, 4 x 3 and 6 x 4 inches.

Construction Features

Parts subject to hard wear are separated, reducing weight and cost and permitting use of special alloys and non-machineable materials. Choice of materials. Adjustable wearing clearance insures maintenance of capacity and efficiency for long periods of operation. Stuffing box is on suction side of pump, limiting pressure on stuffing box to static head of suction. Single suction impellers permit passing of large sphere sizes—aid in obtaining good hydraulic design for a definite rating. Closed impellers are standard—open type available—are interchangeable.

Optional Equipment

The *Equiseal* stuffing box is a new device that eliminates leakage by neutralizing the suction head up to 15 ft. A radially vaned sleeve rotates with the shaft, producing a low pressure area in front of the stuffing box and eliminating leakage.

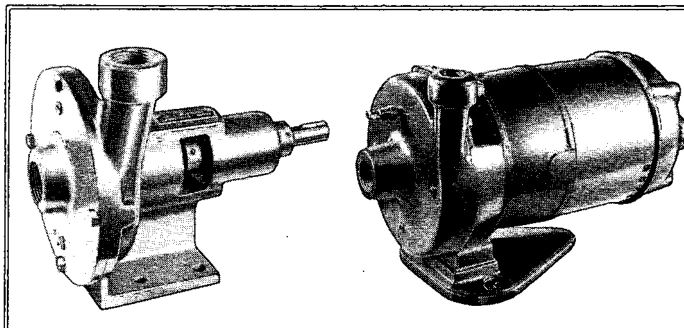
Bulletin 08B6615

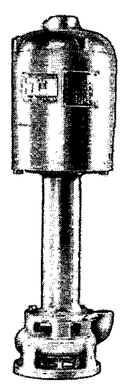
Fractional Horsepower Pumps

Types SSRH — SSCR

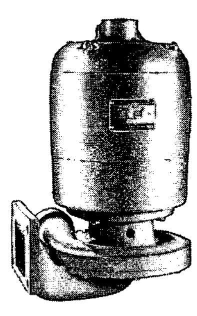
Primarily for the air conditioning industry—but also used for coolant and other small pumping services. Four sizes available—1 x ¾, 1 x 1, 1¼ x 1, 1½ x 1½ inch with both open and closed impellers. Capacities to 80 gpm, heads 125 ft at 3450 rpm. Motors from ⅓ to 2 hp.

Bulletin 52B7529





Type KW is a sidewall mounted, sealless, open impeller pump for handling liquids containing abrasive particles.



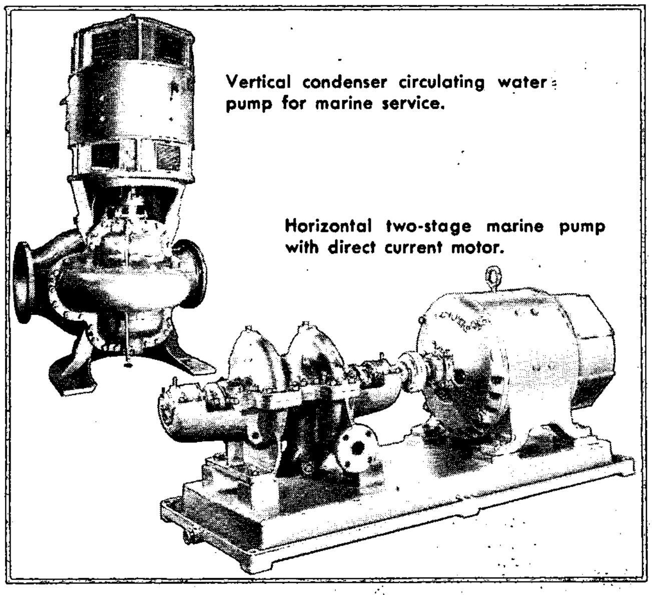
Type CRV handles liquids containing non-abrasive chips, stringy materials or solids.

Coolant and Circulating Pumps

capacities to 250 gpm, heads to 125 ft.

For coolant and general circulating service—either horizontal or vertical mounted. Types available for liquids with abrasives, non-abrasive chips, and stringy materials as well as clear liquids. Explosion-proof motors available.

Bulletin 52B6975



Marine Pumps

capacities to 7000 gpm, heads to 475 ft

There's an Alllis-Chalmers Marine centrifugal pump for practically *every* shipboard need. They range from small drinking water pumps to large condenser pumps—water distilling systems to bilge or salvage service—single stage, single or double suction.

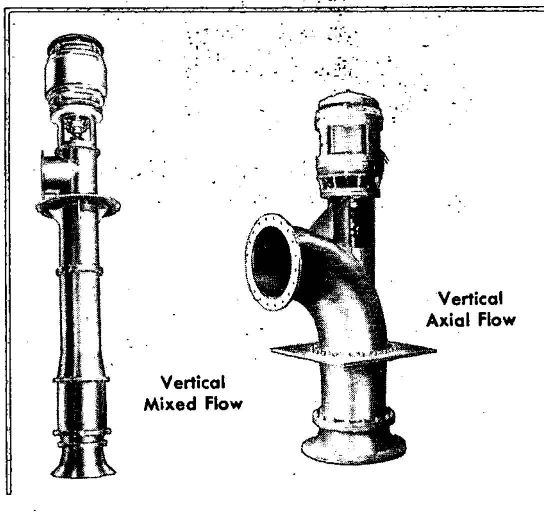
Single stage, double suction type S pumps may be either vertical or horizontal, direct driven by motor or steam turbine; built to handle a few gallons or many thousand. *Electrifugal* units are compact, with motor and pump built as one unit. Multi-stage marine pumps are designed for fire, condensate and feedwater service.

Bulletin 08B6261

Mixed and Axial Flow Pumps

Vertical Axial and Mixed Flow pumps are designed for large capacities at low to moderate heads. They are built with a vertical shaft, an impeller discharging through a diffuser and a column pipe connected to a discharge elbow. These pumps are well adapted for handling condenser circulating water, storm water, irrigation water, flood control, water storage and general water supply.

Sizes from 12 to 54 inch discharge. Capacities from 3500 to 90,000 gpm. Sizes smaller and larger than these can be designed to suit the application.



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